Vol. 37 JULY, 1943 No. 1
Published in two sections—Part 1

QUARTERLY
OF THE

NATIONAL FIRE PROTECTION ASSOCIATION

"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

Printed in U. S. A.

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NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

Vol. 37 July, 1943 No. 1

QUARTERLY

OF THE

National Fire Protection Association

Subscriptions to the QUARTERLY are accepted only as a part of the general publications of the Association which are sent to members. Associate membership is open to anyone interested; annual dues $10.

Entered as second-class matter December 15, 1928, at the Post Office at Boston, Mass., under act of March 3, 1879.

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60 BATTERYMARCH STREET, BOSTON, 10, MASS.

Printed in U. S. A.

National Fire Protection Association

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A NON-PROFIT TECHNICAL AND EDUCATIONAL ORGANIZATION

To promote the science and improve the methods of fire protection and prevention.

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Table of Contents.

San Francisco Navy Pier Fire ..... Frontispiece

Meetings of Board of Directors 5

Letter from New Zealand 11

The Home Front. *L. P. Dendel* 13

Pittsburgh Storage Building Fire. *Photograph* 14

Chicago Gas Holder Fire. *John Plant* 15

U. S. Fire Losses, 1900-1942 17

Safeguarding War Industry. *H. L. Miner* 18

The Nauset Warehouse Fires. *W. F. Farley and H. E. Halpin* 31

Fire Extinguisher Demonstrations. *P. W. Eberhardt* 39

Tire Recapping Shops 54

Carbon Tetrachloride on Magnesium Fires 60

Galveston Cotton Storage Fire. *George F. Rutzler* 62

Cairo Meal and Cake Company Fire 65

Minneapolis Furniture Warehouse Fire 67

Fire Hazard Tests of Building Materials. *A. J. Steiner* 69

Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

San Francisco Chronicle.

This Navy pier in San Francisco, Calif., had a concrete main substructure, but a 20-foot-wide apron of creosoted timber. On May 13, 1943, fire starting in the apron endangered valuable cargo and ammunition stored in the unsprinklered pier shed. Ten fireboats, 17 engines, 6 ladder trucks, nearly four miles of hose and 1700 Coastguardsmen finally brought the fire under control after three hours. 450 feet of the apron was burned, but the cargo was all removed from the shed without loss, and the shed was not burned. Loss $50,000.

The Quarterly

Vol. 37 July, 1943 No. 1

Meetings of Board of Directors.

Chicago, May 10, 1943.

Present.

Albert T. Bell, Chairman
D. J. Price, President
Richard E. Vernor, Vice-President
C. C. Johnson, Vice-President
Alvah Small, Past President
Percy Bugbee, General Manager

A. L. Brown
Frank Epps
George W. Elliott
W. F. Hickey
H. L. Miner
W. J. Scott
E. O. Shreve
John L. Wilds

Business Transacted.

1. The report of the Chairman to the annual meeting was approved.
2. The report of the Treasurer to the annual meeting was approved.
3. A communication from Laurence W. Davis, General Manager of the National Electrical Contractors Association, to Chairman Bell with respect to the Type S fuse situation was discussed and was referred to the next meeting of the Board of Directors for further consideration.
4. It was voted to hold the next meeting of the Board at the Hotel Statler in Boston on June 28.

Boston, June 28, 1943.

Present.

Albert T. Bell, Chairman
David J. Price, President
Richard E. Vernor, Vice-President
C. C. Johnson, Vice-President
Alvah Small, Past President
Hovey T. Freeman, Secretary-Treasurer

George W. Elliott
Russell Grinnell
W. F. Hickey
W. E. Mallalieu
C. W. Pierce
L. G. Schraffenberger
E. O. Shreve
A. H. S. Stead
W. C. Wagner
L. T. Wheeler

Percy Bugbee, General Manager; Robert S. Moulton, Technical Secretary; Horatio Bond, Chief Engineer; Charles S. Morgan, Engineer.

Business Transacted.

1. In accordance with the recommendation of the annual meeting, the following officers of the Corporation were elected for the year 1943-1944: President, David J. Price; Vice-President, Richard E. Vernor; Vice-President, C. C. Johnson; Secretary-Treasurer, Hovey T. Freeman; Chairman of Board of Directors, Albert T. Bell.

2. The Advisory Committee for 1943-1944 was appointed as follows: Albert T. Bell, Chairman; David J. Price, Richard E. Vernor, C. C. Johnson, Hovey T. Freeman, C. W. Pierce.

3. Messrs. George W. Elliott and W. F. Hickey were selected to complete the Nominating Committee for 1944.

4. It was voted to hold the 48th annual meeting in Philadelphia, May 8-11, 1944, subject to possible change at the January meeting of the Board in case of unforeseen developments.

5. The Program Committee for the 1944 annual meeting was appointed as follows: the President, Chairman of the Board of Directors, and the General Manager.

6. The budget for 1943-44 as recommended by the Finance Committee was approved.

7. A proposal that the Chairman of the Fire Marshals Section attend meetings of the Board of Directors was referred to the Advisory Committee with power.

8. A proposal for the establishment of a Transportation Section was referred to the Advisory Committee for a report at the next meeting of the Board.

9. Informal reports on the war emergency activities of the Executive Staff were made by General Manager Bugbee, Technical Secretary Moulton, and Chief Engineer Bond.

10. It was voted to create a Committee on Long-Range Planning for Fire Protection, with the personnel to be appointed by the Chairman of the Board. During the meeting Chairman Bell appointed this committee as follows: Dr. David J. Price, Chairman; George W. Elliott, L. G. Schraffenberger, E. O. Shreve and Alvah Small.

11. Consideration was given to communications on the Type S fuse situation requesting the Board to recommend to the Electrical Committee that the requirements of Section 2452 of the 1940 edition of the National Electrical Code on Holders for Plug Fuses be reinstated by rescinding the previous tentative interim amendment suspending the operation of this requirement for the duration; also communications requesting that the suspension of this requirement be continued in the interest of saving of critical materials and for other reasons. After discussion it was voted to table proposals for reinstating Section 2452. The Executive Office staff was requested to report to the January meeting of the Board on the status of this matter.

12. A question concerning the membership status of associations in the lightning rod industry was referred to the Membership Committee with power.

13. It was voted to invite the Canadian Engineering Standards Association to designate a non-voting representative to the Electrical Committee.

14. Revisions in the Standards for the Installation, Maintenance and Use of Piping and Fittings for City Gas, submitted by the Committee on Gases in accordance with the authorization of the 1943 annual meeting, were approved as follows:

Title:

Change the title of these standards to read as follows, the change being in italics:

"Standards for the Installation, Maintenance and Use of Piping, *Appliances* and Fittings for City Gas."

Section 13. Interconnection of Piping.

Strike out the first paragraph and amend the last paragraph so that as amended the paragraph will read as follows, the new material being in italics:

"Piping systems which are supplied by separate meters shall not be interconnected. Under suitable conditions, provided proper precautions are observed, industrial and commercial piping systems may be exempted from this requirement."

Section 14. Quality of Material.

Revise this section by striking out subparagraph (e).

Section 38A. Gas-Fired Floor Furnaces.

Amend this section by adding the following five new subparagraphs (e to i inclusive), and note reading as follows:

"(e). The floor immediately surrounding the floor furnace shall be reasonably level. When heating two rooms having different floor levels, the furnace shall be installed in the room having the lower floor. It is also well to locate the furnace near the steps, if possible. Where a dual-wall-register furnace is installed between rooms having different floor levels, the furnace shall be installed at the lowest floor level with an approved vertical extension to the upper floor level.

"(f). The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists. The inside dimension of the framework shall be approximately ½-inch longer and wider than the furnace to be installed.

"(g). All floor furnaces, including those having single or dual wall register outlets, shall be installed as approved without alterations, extensions, or changes of any kind in the furnace.

"(h). All furnaces shall be equipped with a gas pressure regulator, which shall be adjusted so the gas input does not exceed the approved input rating.

"(i). If automatic operation of floor furnaces is desired, care must be taken that a model approved for use with an automatic pilot is employed. No automatic pilot shall be installed in the field on a floor furnace that has not been approved for such equipment.

"Automatic safety pilots are recommended for all floor furnaces.

"Note: See Section 1201 of the Building Code Recommended by the National Board of Fire Underwriters (1943 Edition) for further details."

Section 39. Gas-Fired Boilers and Furnaces and Conversion Burners for House Heating.

Sub-par. (a-4). Amend by adding a paragraph reading as follows:

"Limiting controls and low-water shut-off intended to disconnect the appliance from the electric power supply shall be connected into the appliance supply circuit on the supply side of all other control circuits."

Sub-par. (a-6). Amend the second sentence to read as follows, the amendment being in italics:

"In the case of conversion burners the section of the flue pipe between the outlet of the appliance and the draft hood shall not be less than one square inch per 7500 hourly B.t.u. input."

Amend the second paragraph of (a-6) to read as follows, the amendment being in italics:

"In the case of conversion burners, where the outlet from the appliance is larger than the above indicated size, an orifice plate may be inserted or a section of the flue pipe restricted to the size indicated."

At the end of Section 39 add a note reading as follows:

"Note. See Section 1201 of the Building Code Recommended by the National Board of Fire Underwriters (1943 Edition) for further details."

Section 40. Flue Connections Required.

Amend subparagraph (b) to read as follows, the amendment being in italics:

"(b). Automatically controlled appliances with input ratings in excess of 5000 B.t.u. per hour, except automatic instantaneous water heaters *of the single faucet type, where the single faucet is attached to and made a part of the appliance."*

Section 40A. Flue Connection Details.

Amend subparagraph (c) to read as follows, the amendment being in italics:

"(c) Size. *Except as provided in paragraph 30(a-6) for conversion burners,* the vent pipe or connection shall not be smaller than the size indicated by the vent collar of the appliance."

In the next to last sentence of subparagraph (g) strike out the second usage of the word "separate" and insert in its place the word "single," so that the sentence will read as follows:

"A gas appliance vent pipe and a smoke pipe from an appliance burning other fuel may be connected into the same flue through separate openings, or may be connected through a *single* opening if joined by a Y fitting located as close as practicable to the chimney."

Section 41. Flues and Vents for Gas Appliances.

Amend last (fourth) clause of this paragraph by inserting the word "approved," so that this clause will read as follows:

"(4) All other appliances except *approved* appliances which produce flue gas temperatures not in excess of 550° F. at the outlet of the draft hood when burning gas at the manufacturer's input rating."

Section 41B. Installation of Vent Piping Other than Type B.

At the end of the first sentence in subparagraph (a) strike out 41(c) and insert in its place "41(d)."

Revise subparagraph (c) by striking out the words *"other than approved type B vent piping"* and, so that as revised it will read as follows:

"(c) Clearances from combustible material to gas appliance vent piping shall be such that continued operation of the appliance will not raise the temperature of sur-

rounding combustible material or construction more than 90 degrees Fahrenheit above normal room temperature."

Appendix Section 9. Inspection of New Piping.

In subparagraph (a-2), second sentence, strike out the figure "2" and insert in its place the figure "3," so that as revised this sentence will read as follows:

"A pressure of 3 times the expected service pressure, but never less than 3 pounds per square inch (indicated by a 6-inch column of mercury) should be applied."

Appendix Section 12. Location of Meter.

In subparagraph (a) first sentence, the term "shop window" should read "show window."

On recommendation of the Committee on Fire Pumps, Par. 232(e) of the Standards for the Installation and Operation of Centrifugal Fire Pumps, as adopted at the 1943 annual meeting and referred to the Board with power, was adopted as follows: Pumps driven by squirrel cage induction motors, which are automatically started, shall be arranged to run for not less than five minutes each time the pump is started. The inspection department having jurisdiction should be consulted regarding acceptable arrangements.

15. The report of the Committee on Technical Committee Procedure was adopted, including action on the following matters of policy:

Approval of continuing the policy of having N.F.P.A. committees devote primary attention to matters having immediate application in the war emergency and not asking committee members to devote time and attention to routine matters at the present time.

Approval of the policy of continuing to co-operate in the building code project of the American Standards Association in accordance with the responsibilities assumed by the N.F.P.A. in accepting sponsorship of committee projects or representation on committees, but limiting such participation on the part of the N.F.P.A. staff representatives and N.F.P.A. members to such contribution of time and effort as can be made without diverting time from essential war work.

16. On recommendation of the Manufacturing Hazards Council, with the approval of the Committee on Technical Committee Procedure, it was voted to create a Committee on Explosion Venting with the following scope:

Standards for the venting of buildings and equipment to relieve the pressure of explosions of dusts, gases and other materials, but not including ventilation or other measures to prevent the development of conditions conducive to explosions nor excess pressure relief devices on tanks or pressure vessels.

Mr. H. R. Brown of the U. S. Bureau of Mines was appointed chairman, and the Committee on Technical Committee Procedure was authorized to complete the personnel, including liaison representation with other N.F.P.A. committees concerned with explosive materials, and other members especially qualified to serve by reason of research and experience.

17. Technical committee appointments recommended by the Committee on Technical Committee Procedure were confirmed, and the Committee on Technical Committee Procedure was authorized to make further changes in committees as may be indicated by developments prior to the printing of the 1943 Year Book, subject to confirmation by the Board at its next meeting.

The existing members of all technical committees, except for vacancies due to deaths and retirements, were reappointed for the year 1943-44 (the revised committee lists will appear in the 1943 Year Book, to be published as Part 2 of the October, 1943, QUARTERLY).

It was voted to accept the resignation of Honorary Member George W. Booth as Chairman of the Committee on Fire Pumps, and to appoint as chairman Mr. Everett W. Fowler, Engineer of the National Board of Fire Underwriters. It was voted to express to Mr. Booth the sincere appreciation of the Board for his outstanding contribution to the activities of the Association through his leadership of this committee during the years of his chairmanship.

18. A suggestion by Chairman Bell that the Association should take steps to secure more accurate statistics and other information on deaths and injuries by fire was discussed without action.

19. A communication, addressed to trade associations, soliciting the assistance of the N.F.P.A. in a project for raising funds for the support of inter-American activities of the American Standards Association was considered, and it was voted to reply that the National Fire Protection Association is not a trade association and accordingly cannot properly participate in such a project.

20. It was voted to request the Advisory Committee to study the status of the various Sections of the Association with respect to their membership and powers to act on policy matters, and to report thereon at a future meeting of the Board.

21. It was voted to authorize the staff to investigate the establishment of a pension plan for Association employees, to report thereon to the Board at the next meeting.

Letter from New Zealand.

Ensign John B. Fisher of the U. S. Navy, formerly a member of the N.F.P.A. Executive Office staff, and known by many N.F.P.A. members through his series of radio broadcasts on Great Fires of History, has written an interesting letter describing a visit to Auckland, New Zealand.

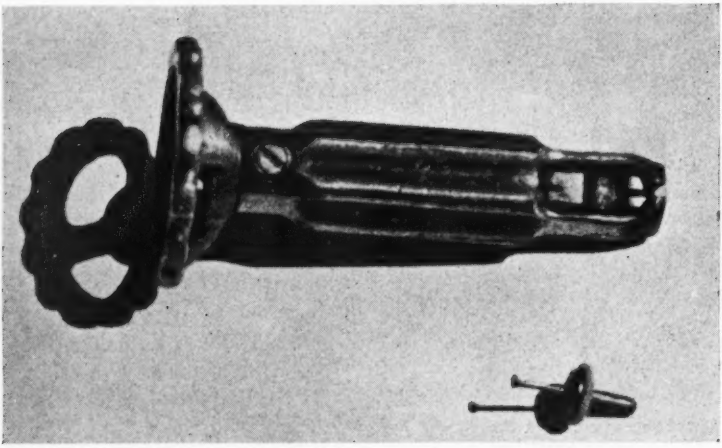
"Some time ago (the censor'd disapprove mightily my saying when), when we dropped the hook in Auckland, New Zealand, for a brief liberty, I took the opportunity to pay a visit to the fire headquarters in that city. I was unusually fortunate in being able to have a long talk not only with Superintendent W. L. Wilson of the Brigade, but also with the Hon. R. Girling-Butcher, Fire Commissioner for the Dominion, who happened to be paying an official call in the city.

"As we discussed fire prevention and protection in New Zealand and the States, the thought came to me that information relative to the Dominion's wartime fire organization might be of considerable interest to the members of the N.F.P.A. With the announced hope of preparing an article for the QUARTERLY on that subject, I toured Brigade Headquarters from cellar to rafter with these officials and with some of the line officers. My plans for that article have been squashed by the censor, perhaps with good reason, for while he feels there'd be no objection to the publication of it in the States, he balks at sending it through the mails from this particular area. Circumstances at present are such as to give his refusal weight, but he will allow me a few general comments here.

"Unlike certain American cities in which auxiliary fire brigades have been treated indifferently or else used for political purposes of dubious merit, Auckland has a permanently organized auxiliary force which for some years has trained as regularly and with as great vigor and enthusiasm as the regulars. Though the manpower drain from the country has been terrific (New Zealand has no peers in her proportionate contribution of fighting men to the cause of the United Nations), it has been possible for Superintendent Wilson to maintain an auxiliary-regular force of 300 men prepared for moment's-notice duty. The city's fire hazards, those of a structural nature particularly, are admittedly serious, but her thirteen fire stations are very strategically located and her fire loss is not exceptional.

"Third Officer Ander of the Brigade, recently returned from active military duty in the Middle East, took a justifiable pride in describing to me the workings of Headquarters' 'central,' its duplex alarm system. Not as elaborate as the systems in effect in many U. S. cities, it nevertheless has a marked efficiency of operation which, after all, is the great desideratum. The number of annual calls received strikes an even average of 1000, which appears to be the maximum that could be handled without undue strain upon the brigade's equipment. Most remarkable of all statistics, however, is the fact that sixty-five per cent of the city's fires are extinguished with first-aid (garden) hose, only five per cent of the total requiring the use of largest size rubber-lined hose. This is a significant wartime note indeed.

"Most of the brigade's mobile equipment, which includes a rather large number of trailers, came from England in exchange for agricultural products exported from the Dominion. Bulking prominently in the headquarters' garages, however, were several 500 g.p.m. pumpers mounted on Ford truck chassis. These, according to the officers and men, were worth their weight in sugar, indispensable to the successful working of the force.



Hose mender captured from the Japanese. Upper picture shows riveter and rivet. Lower view shows how riveter expands part of rivet inserted in hole in hose to be mended.

"When we'd completed our inspection of station and equipment, Superintendent Wilson, Mr. Butcher and I continued our talk at some length. It was at this time that the superintendent showed me an unusual device that had recently been captured from the Japanese and which, duplicated, has been put to very practical use by the New Zealand fire fighters —one of the few instances in history in which anything has been copied from the monkey-men. Knowing that more than a verbal description would be advisable if the device were to be given its due, I had several snapshots made of it, with Superintendent Wilson's permission and co-operation.

"The instrument, a hose-mender, has two integral parts which may be called a riveter and a rivet. Once the rivet is placed in position within the riveting 'bit' it is ready for insertion into any small hole in a hose where a leak has been discovered. A clockwise turning of the riveter head applies a pressure to the rivet that results in its being spread evenly within the hole, a felt gasket, reinforced with a metal shield, covering the area on the outer surface of the hose. Experience with this device over a period of time has proved its worth

to the New Zealand fire fighters. Superintendent Wilson feels that if the instrument could be manufactured in quantity, in a country with the necessary materials for the job, it would soon be in wide demand everywhere. Since the Nips invented it, there need be no fear of patent infringements.

"In bright evidence round the walls of the brigade office were any number of N.F.P.A. publications. Throughout our conversations the respect of these officials for the Association was clearly apparent. So, too, was their respect for Yankee ingenuity and the products that have resulted from it for world benefit. On their side it must be said, however, that New Zealand 'know how,' the Kiwis' improvising skill, is extraordinary. Their mechanical abilities have not only been proved in Africa and on other fighting fronts round the world, but they've been amply demonstrated at home. I doubt very much that any American cities could have done more, with so little, as has been done by the hearth defenders, the fire fighters and craftsmen of Auckland and Wellington and other New Zealand centers. These people must be given great credit. It has been too long overdue.

"I doubt, too, that any people in all the world could be more friendly, more hospitable, more courteous than these. They feel especially indebted to the soldiers and the sailors of the United States, for the fear of Jap invasion that was so great in 1941 has now been almost dissipated. As Fourth Officer Walker of the Auckland Brigade put it, 'I say, Mr. Fisher, you know if it hadn't been for you chaps in these last few months we'd be eating rice right now.' We've helped them, it's true, and been glad to do it, but it's been, definitely, a mutual endeavor, a fine comradeship. Without the strength, the spirit, the skill that New Zealand has offered and is devoting so splendidly to our common cause, I think that the plight of the United Nations would be a hapless and unhappy one today."

THE HOME FRONT

Our soldiers are fighting our battles
In most every tropic and clime.
OUR job is to send food and munitions
And see that they get there on time.
Sure! It's tough to keep plants running
With materials and labor so short,
But we MUST prevent fires and shut-downs
Or these supplies will not even reach port.

So though you are having your troubles
To keep the "old plant" in repair;
You curse the insurance inspector
And you're ready to quit in despair,
Just remember the boys in the Jungle
Fighting the Jap and the Hun.
Do you think for a minute they're saying,
"I'm quitting, it can't be done?"

—L. P. DENDEL (Member N.F.P.A.),
Michigan Millers Mutual Fire Insurance Co.

The war is over for this building. This large Pittsburgh storage building was destroyed by fire on April 6. Employees thought they smelled smoke as much as two hours before the alarm was transmitted. Combustible interior construction, quick-burning contents, and lack of automatic sprinkler protection made it impossible for the fire department to do anything more than save the adjoining property.

Chicago Gas Holder Fire.

By John Plant (Member N.F.P.A.),
Chief Engineer, Fire Prevention Bureau,
Chicago Fire Department.

Twelve men were killed and the world's largest gas holder was totally wrecked when an Army bomber plane, attempting to land at the Chicago Municipal Airport, crashed into the holder located about a mile and a half from the airport.

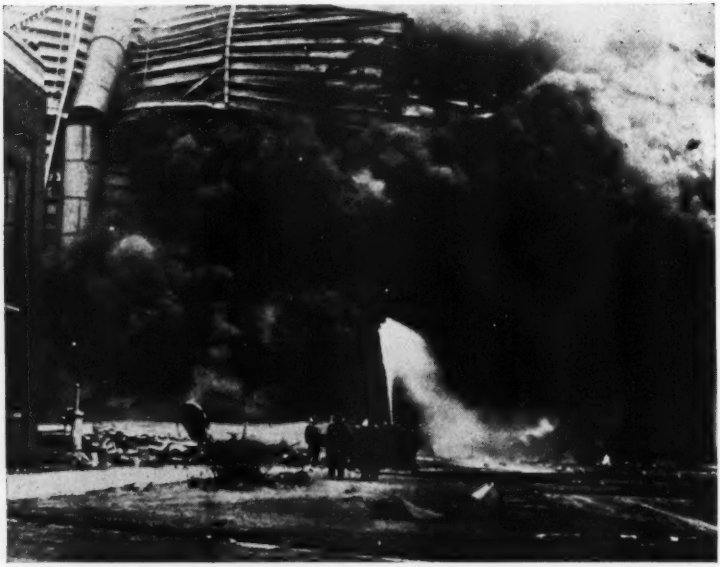
The gas holder was 485 feet in height and approximately 300 feet in diameter. It was built entirely of metal and was of the floating piston type. The piston, which reportedly weighed 1661 tons, was sealed against the side of the holder by a seal of tar. This tar seal was constantly being replenished and pumped to the top side of the piston to maintain the seal and prevent the gas from getting into the top of the holder. The holder had a capacity of 20,000,000 cubic feet of gas, and at the time of the fire there were about 18,000,000 cubic feet of gas and 61,000 gallons of tar in the holder.

Approximately 100 feet from the gas holder was a two-story brick main office building. Near by were a number of buildings belonging to the new Chrysler-Dodge Corporation airplane engine plant, the nearest of these to the gas holder being a power house located about 1250 feet away. A large concrete grain elevator was situated about 800 feet in another direction from the holder. Luckily, the explosion and fire did not involve any of these exposed buildings. The only damage to the office building resulted when the explosion blew out two panes of glass.

Story of the Fire.

The airplane, a B-24 Liberator four-motored bomber, had left Dallas, Texas, for St. Louis early on the morning of May 20, 1943. Weather Bureau records show that it was raining and foggy, and visibility was low. The plane was not allowed to land at St. Louis, but was ordered to proceed to Chicago. At 11:45 A.M. the plane had circled the Chicago Municipal Airport once and was headed south when it rammed into the side of the gas holder. Almost immediately a terrific explosion occurred, wrecking the holder and scattering heavy pieces of metal around the surrounding area. Several of these pieces of metal buried themselves three or four feet deep in the ground.

The engineer of a Chicago fire company located on the premises of the Chrysler-Dodge plant heard the plane go over, flying low and headed toward the airport. A few minutes later he heard the crash and explosion. He could not see the holder due to the low visibility, but did observe a dull red glow some distance away.



International.

Chicago firemen are shown fighting the blaze which resulted when an Army bomber sheared the top off a huge gas holder containing 18,000,000 cubic feet of gas. The office building shown at the left, located about 100 feet from the holder, escaped damage.

The first alarm was received at 11:46 A.M., the second at 11.53 A.M., the third at 11:56 A.M., and the fourth and last at 12:10 P.M. The Chicago Fire Department responded immediately and stretched long lines of hose from distant hydrants. Thick billows of smoke from the burning oil and tar handicapped the fire fighting activities. The blaze was under control at 3:00 P.M. and completely extinguished at 9:00 P.M.

All twelve occupants of the bomber lost their lives, and the plane was a total wreck. The gas holder, which represented 20% of the total gas storage in Chicago, contained gas valued at $15,000, and will cost $1,250,000 or more to replace.

Three Previous Chicago Gas Holder Accidents.

June 11, 1923. A waterseal, telescopic-type gas holder of 5,000,000 cubic feet capacity collapsed from unknown cause. Gas issued from holes in the top and sides of the holder, which was about 175 feet in diameter and 180 feet in height. Gas ignited and burned for approximately ten minutes, the ball of flame rising from 800 to 1000 feet in the air. Several near-by frame structures were set afire, and a number of persons were burned. All fires were extinguished with hand pumps.

July 20, 1925. A waterseal gas holder of 5,000,000 cubic feet capacity, 180 feet in diameter and 175 feet in height, was located on the bank of the Chicago River. A gasoline barge, containing nine cylindrical steel tanks, all located in one large compartment below the steel deck, was wrecked by an explosion of unreported cause. Large pieces of the steel barge were hurled in all directions, and one piece of steel came down through the top of the gas holder, tearing a big hole in the top. No fire or explosion resulted.

August 9, 1930. A sightseeing plane crashed into a telescopic-type, waterseal gas holder of 1,000,000 cubic feet capacity, 120 feet in diameter and 100 feet in height. No fire occurred and the holder did not collapse. The three occupants of the plane were found drowned in the bottom of the tank.

U. S. Fire Losses, 1900-1942.

The following table of fire losses for the United States for 1900 to 1942 has been prepared by the National Board of Fire Underwriters (Member N.F.P.A.). The loss figures are based upon losses reported to the National Board by insurance companies, with percentages added to cover uninsured and unreported losses. The index figure for fire losses taken with 1926 as a basis was arrived at by using the amount of insurance written each year as a measure of property exposed to destruction by fire and adjusting for fluctuations in commodity prices.

Year	Aggregate Property Loss	Index of Fire Losses 1926 = 100	Year	Aggregate Property Loss	Index of Fire Losses 1926 = 100
1900.....	$160,929,805	145.6	1922.....	$506,541,001	123.0
1901.....	165,817,810	139.1	1923.....	535,372,782	110.9
1902.....	161,078,040	133.5	1924.....	549,062,124	115.6
1903.....	145,302,155	114.9	1925.....	559,418,184	109.8
1904.....	229,198,050	168.9	1926.....	561,980,751	100.0
1905.....	165,221,650	113.8	1927.....	472,933,969	88.3
1906.....	518,611,800	342.8	1928.....	464,607,102	84.4
1907.....	215,084,709	125.7	1929.....	459,445,778	79.0
1908.....	217,885,850	129.7	1930.....	501,980,624	94.0
1909.....	188,705,150	105.9	1931.....	451,643,866	89.8
1910.....	214,003,300	112.2	1932.....	400,859,554	88.6
1911.....	217,004,575	110.9	1933.....	271,453,189	62.1
1912.....	206,438,900	102.5	1934.....	271,197,296	56.5
1913.....	203,763,550	98.0	1935.....	235,263,401	47.9
1914.....	221,439,350	104.1	1936.....	266,659,449	56.1
1915.....	172,033,200	77.3	1937.....	254,959,423	52.1
1916.....	258,377,952	103.6	1938.....	258,477,944	54.4
1917.....	289,535,050	103.1	1939.....	275,102,119	57.7
1918.....	353,878,876	110.1	1940.....	285,878,697	57.3
1919.....	320,540,399	91.6	1941.....	303,895,000	56.1
1920.....	447,886,677	99.1	1942.....	314,295,000	49.7
1921.....	495,406,012	135.4			

Safeguarding War Industry.

By H. L. Miner.

Fire prevention and fire protection have always played an important part in our civil and industrial life. Today fire prevention and fire protection is a signal factor in and a vital phase of industry.

We are all cognizant, must be, of the necessity of conserving every bit of material which may be used for the furtherance of our great struggle for victory and the immediate obligation of allowing nothing to curtail, delay, or stop the increased production of war matériel. The importance of adopting and following accepted measures to prevent fires; the provision of adequate first aid and major fire fighting appliances and equipment—protection which has proved its value and stood the test in many fires—have not always received the consideration merited.

I know of no fire or conflagration which could not have been prevented or limited in scope through proper building construction, location, separation or cut-offs, and fire protection coupled with effectual fire preventive measures. Nearly all, if not all, serious disasters have resulted from causes which should have been recognized and cared for, or were due to neglect in providing and properly maintaining adequate fire control equipment.

There is nothing obscure, mysterious, nebulous or vague about fire protection and fire prevention. The fundamentals are simple, easy to understand and apply. Their application demands, largely, good old common sense. I often wonder why it is such a Herculean task to convince people of the need of accepting and applying these fundamentals. For example, the simple day-by-day practice of good plant housekeeping, including orderly arrangement and procedure, is one of the protective measures most difficult to have permanently adopted and constantly maintained. Yet, this one measure will not only prevent fires and explosions, but increases production, promotes greater efficiency, improves quality of product, and contributes to plant betterment and employee morale.

Let us review a few of the recent disastrous fires and explosions from the standpoint of (a) the money loss; (b) the loss of vital materials; (c) the interruption or curtailment of plant operations; (d) the possible effect upon our war effort.

First, we will review the deficiencies which, singly or combined, resulted in the largest single industrial fire loss in recorded history and in the destruc-

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This article was presented as an address at the 47th Annual Meeting of the National Fire Protection Association, Chicago, May 13, 1943. The author is Manager of the Safety and Fire Protection Division, E. I. du Pont de Nemours & Co.

tion of one-tenth of the crude rubber supply in the U. S. A., a loss which has affected every one of us.

During the first week in October, 1941, 15,850 tons of crude rubber belonging to the Rubber Reserve Corporation and 3000 tons belonging to the Firestone Company were stored in several closely grouped old buildings. The first two lower floors of one building had been removed to permit high piling and storage of a larger quantity of rubber than would have been possible due to the limited load carrying capacity of the floors. In an adjacent building, pads of various kinds of foam latex, gas masks, barrage balloons, leak-proof gasoline tanks, cartridge clips, rubber thread, and other mechanical rubber and plastic products were being made. The foam rubber department was located on the third floor. The operation consisted of agitating liquid latex, a mixture of rubber, ammonia, water, and chemicals. It was poured into molds or containers and after being cured, removed from the molds and washed, then placed in racks in a dryer unit to remove all the moisture. The metal dryer was 13 feet wide, 36 feet long, and 12 feet high. The building, with the exception of the dryer, was equipped with automatic sprinklers. But for the facts that some 37 million pounds of crude rubber were destroyed, at that time one-tenth of our national supply, material urgently needed for war production and irreplaceable; that the fire caused an estimated loss of $15,000,000; that a large number of men (newspaper account stated 2000) were thrown out of work and production stopped on vital war material, this disaster might be entitled "A Comedy of Errors," as well as "The Rubber Tragedy of World War II."

The fire occurred in the dryer about 10:30 P.M., while seven men were working near by. The first indication was smoke issuing through the cracks around the doors.

Automatic sprinklers had been recommended for protecting the interior of the dryer. The recommendation had been agreed to, the fabricated pipe and sprinkler heads were on hand, but had not been installed.

The night shift did not include a fire brigade, although several members of the mechanical force were on duty that night. The workers had not been instructed or trained in fire fighting and apparently were not familiar with available fire protection equipment. However, the sprinklers around the dryer operated and the employees with extinguishers were controlling the fire.

About fifteen minutes after the fire was discovered the watchman, believing that the fire was under control, closed the two 8-inch outside sprinkler control valves in order to prevent excessive water damage on floors below.

When the fire department responded, the first plant hydrant they attempted to use was found defective. Another hydrant, later on, was found to be inoperative.

International.

The smouldering ruins of the Firestone Rubber and Latex Products Co. buildings, after the $15,000,000 Fall River fire which started on October 11, 1941.

When the assistant city fire chief attempted to telephone for additional equipment the telephone system, apparently due to water running through the floor on to the automatic switchboard, was out of order.

It is reported that about this time the electrician, in order to safeguard the firemen, shut off the light and power electric lines at the substation.

A city ladder truck became jammed in a passageway because of its length, and three pumpers had to be backed out so that the ladder truck could be moved.

The apparatus was then taken to the main gate, but it was locked, unguarded, and the key could not be located. One of the firemen had to jump the fence and break the lock so that the apparatus could enter.

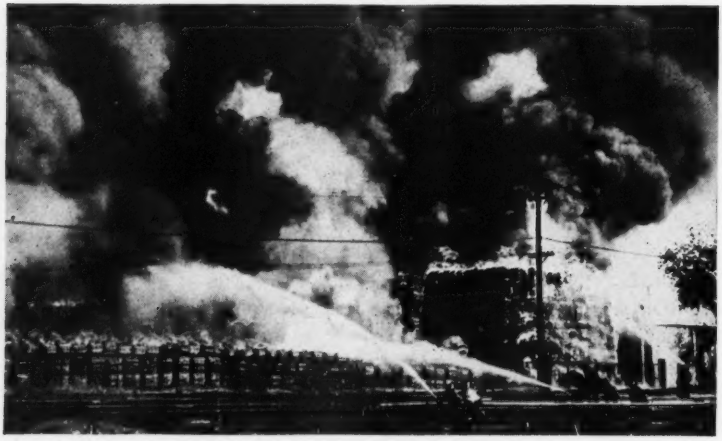
When it was discovered that the watchman had closed the sprinkler valves they were immediately opened, but in the meantime the fire had spread from the dryer to some 30,000 lbs. of sponge rubber stored on racks near by. The rubber burned with great rapidity, opening all the sprinklers on that floor and a large number on other floors, seriously overtaxing the water supplies. There were more than 600 heads on each floor.

The fire then spread beyond control and the heat was so intense that the sectional control valves in the courtyard could not be closed to prevent wasting the water through the large number of opened sprinklers.

Several important fire doors, it is reported, failed to operate automatically, allowing the fire to spread.

Fifty-eight towns and cities, within a radius of as many miles, sent equipment. Eight hundred firemen worked at the fire, 74 pumpers were on hand, 47 of which were used. It is estimated that approximately 25,000,000 gallons of water were taken from the city water supply, and it is impossible to even approximate the additional millions of gallons which were discharged on the fire, as most of the pumpers drafted from Crab Pond and Mount Hope Bay.

If automatic sprinklers had been installed in the relatively small dryer the fire would undoubtedly have been extinguished in the dryer, as the hazard was not severe. If the employees and watchman had been familiar with the fire extinguishing appliances and had been trained in their use, the confusion during the early stages would have been prevented. The fire unquestionably would have been controlled even though the dryer was unsprinklered. If the watchman had been thoroughly instructed in the operation of the automatic sprinkler systems, the water would not have been turned off before the fire was completely extinguished. It is stated that if, at the outset, one good hose stream had been directed at the seat of the fire, the fire probably could have been extinguished even with the automatic sprinklers shut off. If it had been possible, after the fire had spread beyond control in the original building, to close certain sectional control valves in the yard mains, the waste of water might have been reduced to a point where the automatic sprinklers in the



International.

Firemen responded to fifteen alarms and used some fifty hose streams in attempting to control this blaze, which caused approximately one million dollars loss in a cork storage yard at Baltimore, Maryland, September 17, 1940.

adjacent buildings could have prevented the fire from entering. The locked gate with the key missing and the defective hydrants, which the fire department attempted to use, defy comment. The excessively large storage of rubber in one fire area subjected tremendous values to one fire. The fact that the city fire department was not thoroughly familiar with the entrance used and that the gate normally used was locked and without the services of a guard is another indication of the need of adequate guard and watchman service at all times.

Cork, like rubber, is on the priorities list. Ten thousand tons of cork, a year's supply, were bought up before shipments from Europe were stopped, and were put aside in a Baltimore yard. Where is that cork today? It was completely destroyed in a million-dollar fire that took place in September, 1940. Despite the experience of previous fires, the cork had been too closely piled in a 9-acre storage yard. A chance spark was enough to set the whole lot ablaze, and 450 firemen and 60 pieces of apparatus were unable to check the flames.

On January 10, 1942, a fire occurred in a grain elevator at Superior, Wisconsin. The fire started at the top of a conveyor leg from friction on the belt. It was followed by three explosions which wrecked the sprinkler system —loss $1,352,962. Grain destroyed would have provided sufficient bread rations for an entire year for an army of 700,000 men, and, in addition to the food loss, shipping and storage facilities at the head of the Great Lakes were seriously affected.

Acme.

Grain elevator at Superior, Wisconsin, was destroyed by fire on January 10, 1942, with a loss of $1,750,000. Violent grain dust explosions following the start of fire, due to mechanical failure in an elevator leg, wrecked the sprinkler system.

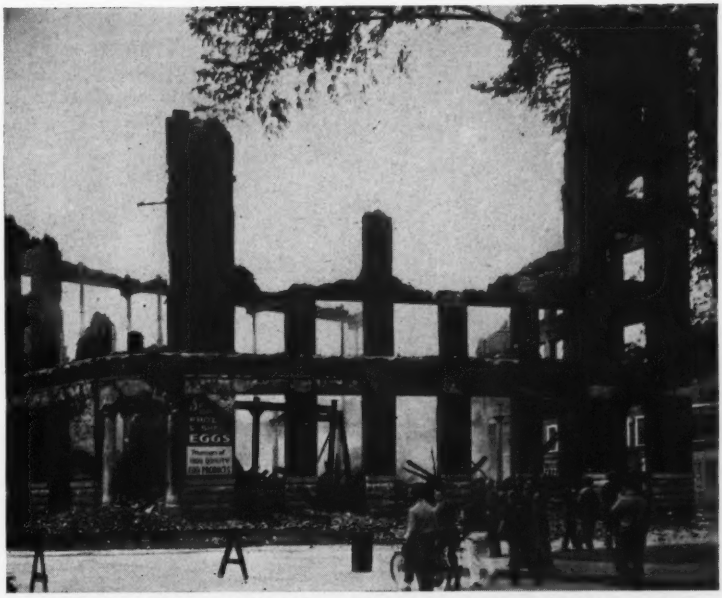
On June 12, 1942, in Dubuque, Iowa, a fire originating in an overheated dryer totally destroyed an egg processing and wholesale grocery plant. Employees fought the fire with chemical extinguishers and thought they had extinguished the blaze, but it broke out anew. Upon the arrival of the fire department the flames were beyond control. Open stairways, elevator shafts, and unprotected chutes communicating from floor to floor contributed to the rapid spread of fire. Over 250,000 pounds of powdered eggs, destined for shipment to the war areas, were destroyed. Loss approximately $500,000, but I am told that some of our soldiers and those of our allies on the fighting front seriously felt the destruction and curtailment of this food supply.

On February 23, 1943, in Saginaw, Texas, a severe dust explosion occurring in the vicinity of the unloading shed demolished several mill buildings of a flour mill and elevator. Resultant fires ignited the wooden roof of a warehouse, which collapsed and broke the water supply line to the sprinklers under the roof. Bad housekeeping due to inadequate ventilation and cleaning of a hazardous, dusty area was the probable cause. Loss about $1,250,000.

On February 28, 1943, fire of unknown origin started in a warehouse of a waterfront grain mill in Oakland, California. Flames fed by accumulations of grain dust spread rapidly through the entire plant. The fire department was hindered in reaching the scene by sightseers blocking the only road to the plant. The water supply was inadequate, only two hydrants connected to an

San Francisco Chronicle.

Fires destroying foodstuffs continue to handicap the war effort. This Oakland, California, fire on Feb. 28, 1943, destroyed grain and grain handling equipment with a loss variously estimated at $3,000,000 or more.



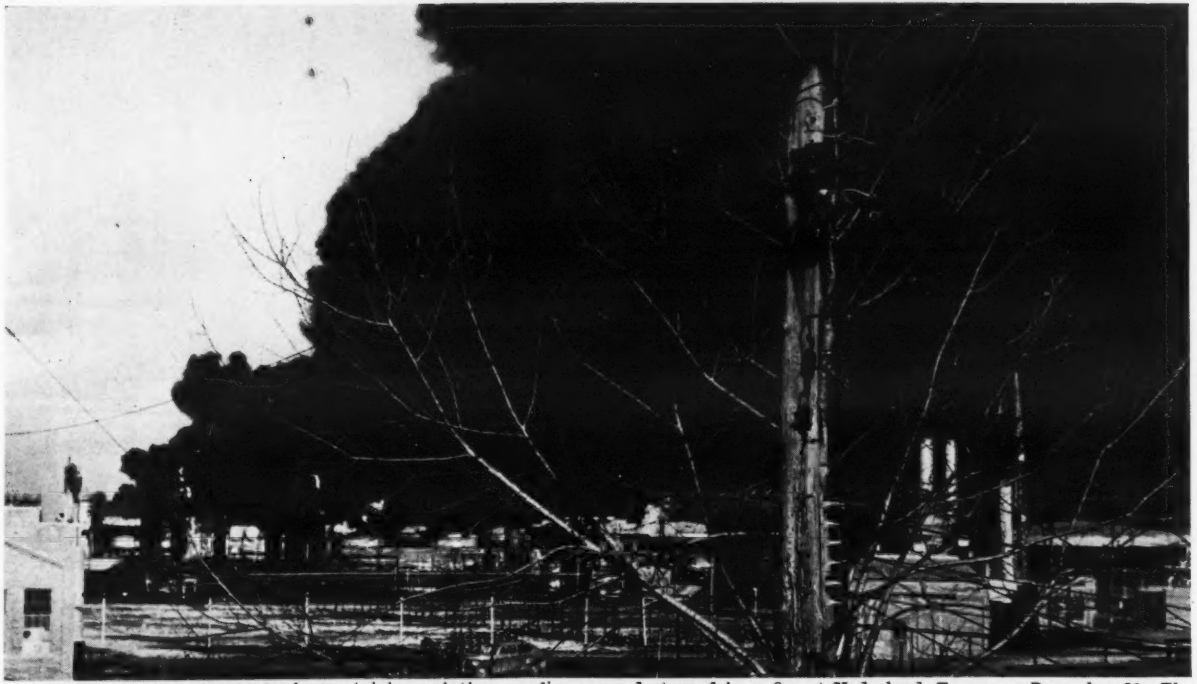
At Dubuque, Iowa, shortly before midnight on June 12, 1942, this egg processing plant and an adjoining poultry produce plant were destroyed by a fire starting in an egg dryer. An alarm was delayed some twenty minutes while employees fought the blaze with first aid appliances. When firemen arrived the entire building was involved. A falling wall carried the fire into the adjoining plant.

8-inch dead end main were available to provide water. The magnitude of the blaze made any hose streams appear ineffective. Loss $3,000,000.

These two fires destroyed or damaged sufficient grain to furnish necessary cereal rations for one year for an army of over 600,000 men. The crop loss represents the annual productive capacity of approximately 2000 grain farmers and over 150,000 acres of wheat land. The equipment lost was sufficient to process and store cereal foodstuffs for millions of civilians.

Is it not obvious that a little forethought and care could and would have prevented these enormous money losses, saved vitally needed matériel of war, and prevented unnecessary delays in production? Our men on the fighting front deserve all the food, munitions and equipment—the maximum—that the home front is capable of providing. This obligation cannot be met with delays or curtailed production or destruction of needed materials.

Several of the fires just reviewed vividly portray the tragic results of inadequate protective measures with regard to organization, education, instruction, and training of plant personnel. Others demonstrate what may be



Thirty refinery storage tanks containing aviation gasoline were destroyed in a fire at Nederland, Texas, on December 29. The loss is estimated at $500,000. The plant was completely shut down for 10 days following the fire before even partial operations could be resumed.

expected of combustible or nonfire-resistive contruction, when well-known fire and explosion hazards are disregarded, with inadequate or no fire protection, and lack of proper maintenance and good housekeeping. On the other hand, many fire summaries could be presented to prove the inestimable value of ordinary fire fighting facilities, such as first aid equipment for controlling the fire in its incipiency; automatic sprinkler installations, inside and outside hose protection; substantial primary and secondary water supplies, dependable alarm service, well-trained fire fighting organization, etc. These usual installations have saved and daily are preventing losses which would otherwise amount to millions of dollars; but more important, they are maintaining continuity of manufacturing operations so vital to the war effort.

I will not attempt to outline or discuss the preventive and protective measures which preclude disasters, and any incident which delays our all-out war effort, regardless of monetary loss, is a disaster. The fundamentals of fire prevention and fire protection are available, are as well known to many, if not all of you, as they are to me. They are useless, however, unless applied, made effective, definitely removed from the realm of speculation and made a reality.

One of the hardest problems the fire protection engineers have to meet is to convince those in authority of the need of considering adequate fire protection measures in the design, construction, equipment and operation of plants. Qualified fire protection engineers should be consulted and their recommendations followed systematically and literally.

Our problem of adequate protection must embrace an over-all consideration of the solution to the end that there must be a constant, continuous flow of tanks, guns, planes, bombs, ships, destroyers, submarines, and other matériel of war.

Many times when materials are not available or are limited it becomes necessary to decide where and to what extent improvements can be made or safeguards provided. Here is a point at which the line of demarcation between the desirable or necessary, the theoretical or practical, the sentimental or cold blooded common sense, must be drawn.

Let us not be penny wise and pound foolish. When unable to fully protect existing plants in their entirety, a careful study should show where the critical points or bottlenecks exist. Specific protection of those units may prevent disaster—prevent relatively small fires from disrupting operations.

Suppose we do have, in modern warfare, large amounts of explosives and bombs, but have no planes to carry and drop them—why manufacture the explosives or bombs, they are useless. Therefore, the adequate safeguarding of the production of planes becomes paramount.

Now reverse the situation—we have planes, but no gasoline to operate them, no explosives or steel to manufacture bombs—so why manufacture planes? Is it not evident that the safeguarding and protection program must

Providence Journal.

This huge shipyard fabricating building in Providence, R. I., burned on December 31, 1942. The frame of the building was steel, and the contents heavy machinery and steel in process, but the walls were plywood and the roof wooden plank. No automatic sprinklers were provided, and there was no fire wall between the small section at the left, where the fire started, and the main area. Employees fought the fire for 15 minutes before calling the Providence Fire Department.

be a thoroughly balanced one, fully co-ordinated and correlated within the entire manufacturing industry?

Perhaps such a balanced program has been effected. We can all sincerely hope so, but if not, no time should be lost in accomplishing this result.

During 1942 the Plant Protection Division of the Office of the Undersecretary of War prepared and distributed a pamphlet entitled "Plant Protection for Manufacturers." The Plant Protection Division was later transferred to the Office of the Provost Marshal General. The pamphlet has recently been revised, is now being reprinted and will be made available—distributed to all manufacturers having war contracts.

One chapter is devoted to Fire Protection and Fire Prevention. It briefly, yet comprehensively, sets forth the measures necessary to eliminate or control the inherent hazard of interruptions to operations, as well as safeguarding the plant and production. You will note that I am stressing the vital necessity of maintaining uninterrupted operations as well as preventing the destruction of war matériel.

The National Fire Protection Association has recently prepared and made available a number of informative books and pamphlets pertinent to the war effort. The Crosby-Fiske-Forster Handbook of Fire Protection has been revised and published in the ninth edition. It is invaluable to the fire protection engineer and the manufacturer, and should always be available as a reference book. A recent N.F.P.A. publication is entitled "Industrial Fire Brigades Training Manual." The first paragraph, under the caption Foreword, written by Percy Bugbee, General Manager, states: "Many large and important industrial plants have enjoyed immunity from serious fires for long periods of time. This is not a matter of luck, but the result of careful planning." He further states, "It usually means that the plant has an organization among its employees for fire safety. Thus, there is someone all the time thinking about fire emergencies and planning for them. Such a plant is better protected because fire situations are recognized and protection provided. Even more important, available protection will be properly maintained." Other publications, such as "National Fire Codes for Extinguishing and Alarm Equipment," "National Fire Codes for the Prevention of Dust Explosions," "Fire Defense," "The National Electrical Code," and similar regulations give full return for the associate membership investment.

Plants working on war contracts have likely been inspected or surveyed by Internal Security Inspectors or by engineers of the insurance associations or companies carrying the risk. Recommendations probably have been made for improving conditions to prevent fires and explosions; to limit their spread, additions to fire fighting equipment have been suggested, and recommendations made for more adequate maintenance and the inauguration and training of plant fire brigades. All this effort is of no value, is wasted effort, needless

labor, unless the recommendations are seriously considered and carried out. In fire prevention and fire protection nothing is too small or insignificant to receive attention. Compliance with such recommendations may mean the difference between a disaster and no loss.

There are yet to be established authentic cases of sabotage or incendiarism involving critical war matériel, using these terms in their accepted meaning. The manufacturer or operator who becomes the victim of a saboteur should not be censored in the event of fire, provided he has guarded his plant as effectively as possible, even though the protective measures had been circumvented. However, the manufacturer or operator who through indifference, complacency or self-sufficiency fails to heed the advice of competent fire protection engineers is perhaps more guilty in event of a disaster than the most flagrant saboteur.

Much can be done to safeguard operations and production which will not require additional equipment or structural changes, to wit:

Maintain good housekeeping; prohibit smoking on premises; limit the amounts of flammable and explosive materials in operating buildings to the necessary minimum; maintain all fire equipment in first-class operating condition, whether fire doors or fire fighting appliances; be sure that all employees know the location of available fire extinguishers, their scope and how to use them effectively; organize plant or building industrial fire brigades, especially training the employees in the use of major fire fighting equipment; check watchman and guard organization to insure completeness as to coverage and adequacy of education and training; co-operate with such outside agencies as are available to assist in event of disaster, etc. These measures will do much to protect your plant from production interruptions and loss.

No one can question the necessity for safeguarding the production of war defense materials and the facilities used for their production.

The following lines of poetry, it is said, were found on the body of a Marine somewhere in the Far East:

"And if our lines should form, then break,
Because of things you failed to make—
The extra gun or ship or plane
For which we waited—all in vain,
Will you then come and take the blame
For those supplies that never came?
For we, not you, will pay the cost
Of battles you, not we, have lost."

Munitions, food, clothing and other war matériel must be provided in ever increasing amounts to control and master the destructive forces which have been loosed in the world. Success in defending the democracies of today depends upon our ability and determination, your individual and collective responsibility, to maintain the continuity of production.

The Nauset Warehouse Fires.

By W. F. Farley and H. E. Halpin,
Associated Factory Mutual Fire Insurance Cos.

Two fires four days apart at the Nauset Warehouse in New Bedford, Massachusetts, emphasized several important fundamentals of vital interest today on the storage, protection, fire fighting, and salvage of jute and cotton.

This was a public warehouse of brick, plank-on-timber construction, equipped with automatic sprinklers with a good water supply. The warehouse was separated by fire walls into five high 1-story sections, and one 2-story section. Three sections were involved by fire, and contents of a fourth suffered water damage. In terms of dollar value the loss was estimated at $400,000. In terms of loss of critical materials and salvage difficulties it was of even greater consequence.

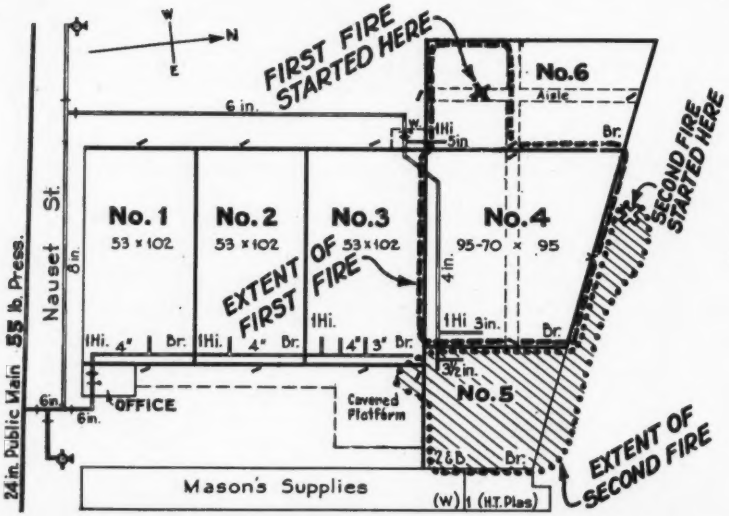
Story of the Fire.

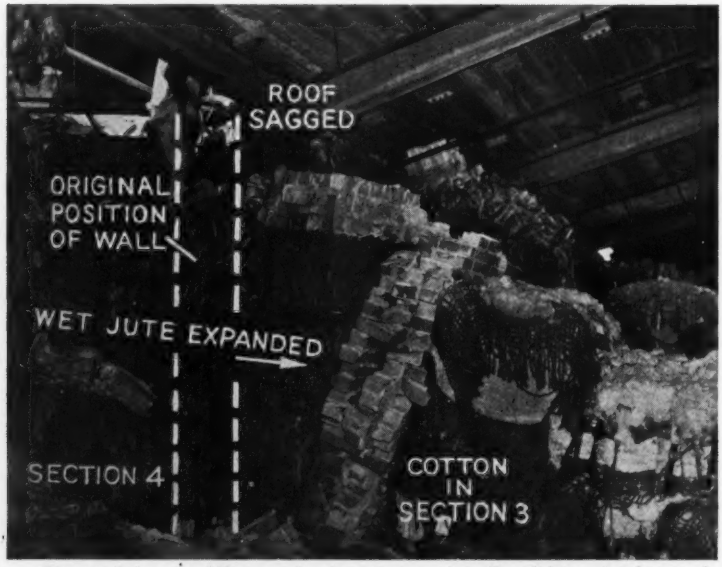
The first fire started in Section 6 (see sketch, page 32), about 1:15 P.M. on Thursday, March 25. This section contained about 1500 bales of jute and 1500 bales of cotton, in adjoining piles 20 feet high. On a column was a power outlet, poorly arranged because half-hidden by cotton bales. Into this outlet an operator inserted a plug for an electric hoist; some defect produced arcing, which threw off sparks, and quickly the fibres on the surface of the bales—only a few inches away—ignited. The man tried to beat out the fire with his hands, but it spread with great rapidity up the face of the piles, too quickly also for the fire pails and extinguishers which were next tried.

One employee ran to the office and sent in the alarm. Another ran and closed the fire door into Section 4, but he reports that the fire had already flashed over the cotton and jute and into Section 4—before enough heat was developed to operate the fusible link on the door—a possibility because the jute was piled close to the doorway on each side. Meanwhile the automatic sprinklers opened and beat down the fire.

Fire Fighting Operations.

When the firemen arrived with their usual promptness, they put two streams into play through the south door. Smoke soon became dense. Skylights were opened for ventilation. The top jute bales swelled, broke their jute rope bindings, and the loose "hands" of jute mushroomed out and toppled into the aisles, blocking them; but with the sprinklers operating, the cross-aisle kept fire from the north half. The swelling jute also started to push the top of the wall toward Section 4. These conditions soon forced firemen to withdraw, using the streams from outside through doorways and skylights. This was about a half hour after the fire's start.





The need for providing ample clear spaces at walls of jute storehouses is shown above. The expansion of the wet jute bales in Section 4 at left has pushed the brick wall about six feet into Section 3.

A section of the warehouse not involved in the fire, showing high piles of jute (left), and (right) a power outlet behind a metal guard and in close proximity to the bales. The fire started in a similar location, where cotton was piled.

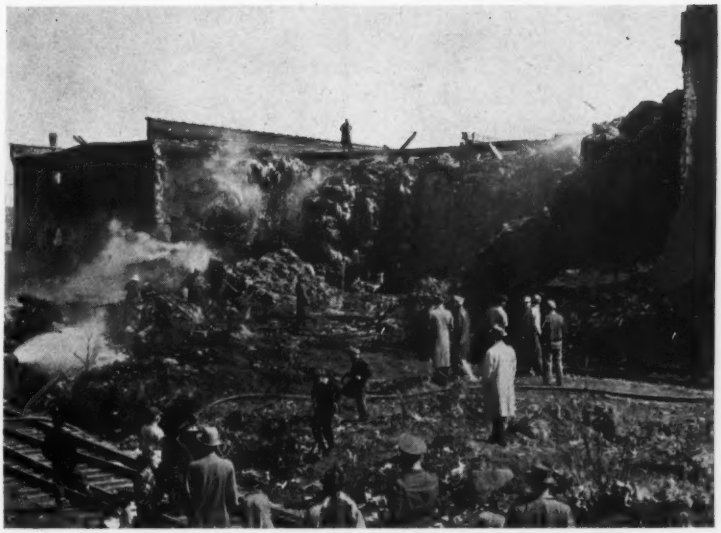
Meanwhile, sprinklers had also opened in Section 4, which was filled wall to wall with 9000 bales of government-owned jute, also piled 20 feet high, with a 6-foot aisle running down the room longitudinally. Sprinklers held the fire. However, the top tiers of bales, absorbing water, swelled, and about 2:30 P.M. pushed out the outside wall, toppling it and bales of jute onto a siding. This let the roof down on top of the jute, and also broke a 3-inch sprinkler pipe feeding the north half of the building. The fire then blazed up, burning underneath the north half of the roof where sprinklers were dead, and in the jute storage under it. In the south half, despite loss of water from the broken pipe, sprinklers apparently were still well enough supplied to keep the roof from igniting, and the jute from burning.

During the night the expanding wet jute forced the opposite wall into Section 3, causing its roof also to sag and breaking a 4-inch sprinkler pipe feeding sprinklers in Sections 4 and 5, putting them out of service. Fire did not get into Section 3 because sprinklers had held it in the south half of 4, where there was not much burning. The fire in the north half of Section 4 burrowed into the pile between the bales and seven hose streams were used all night.

What smoldering fire remained in the cotton bales in Section 6 was kept from bursting out again by keeping sprinklers in operation. Although the broken pipe to Section 4 bled much of the water supply for Section 6, the

Nine thousand bales of jute—part of the Government's stock pile of critical materials—were badly damaged by fire and wetting. Swelling of wet jute forced out the brick wall, and broke sprinkler piping. High-piled jute and cotton in other sections were also damaged.

This is the same building four days later, just after a second fire burned out Section 5 at far left. Sprinklers were out of service, although work to restore this protection was in progress. The crane in the foreground was used to remove the burned roof following the first fire.



This is how Section 4 looked one month after the fire.

stock had already been well wet and sprinklers still got enough water to hold the fire down. At noon the next day they were shut off, being no longer needed. Later, as smoldering fires threatened to burst out, they were turned on from time to time.

The next morning, Friday, March 26, a crane was brought in and the burned half of Section 4 roof was removed, to let hose streams get at the burning jute below. The planks on the other unburned half were removed by hand. The firemen continued using hose streams as needed until late Sunday, when they withdrew, leaving lines of hose laid to Sections 4 and 6, under pressure, the water being shut off at the nozzles.

W.P.B. Rules Delay Sprinkler Restoration.

After any fire it is vitally important to put sprinklers back into service, to be prepared for a possible second outbreak. Early Friday a contractor was engaged for this work, which required priorities for materials. Local and Washington War Production Board officials acted promptly, but because of the time required for a written permit to arrive, the work actually did not start until noon the next day, Saturday.

That afternoon and Sunday the work of restoring sprinkler protection to Section 5 proceeded. The broken 4-inch pipe in Section 4 was capped. The 3-inch in Section 3 was replaced with a 4-inch as a new feed ready to be connected to Section 5. A new valve was installed controlling the half of Section

These salvage views one month after the fire show the bales of cotton removed to a near-by field, with piles of jute in the distance (above), and the interior of Section 3 (below).

3 where the roof was sagging. This showed good judgment because later a pipe broke and by shutting the valve it was possible to maintain the automatic sprinklers in service in Sections 1, 2, and half of 3.

Story of the Second Fire.

The next day, Monday, March 29, the men were about to connect the sprinklers in Section 5 with the new feed when, shortly after noon, fire started in jute on the ground outside Section 4, possibly from smoking or a spark from a gasoline engine-driven crane. Two men hurried to the roof of Section 6, turned on the nozzle of a hose left in readiness. A 14-mile wind, however, drove the fire over the jute to baled cotton on the platform of Section 5, through an open door into Section 5, where the sprinklers were out of service.

Promptly the fire department was again called. They came with five pumpers, put eight hose streams into use, aided by Coast Guardsmen from a near-by station. However, because sprinklers had not been restored, the fire went through both floors of Section 5, got into all the cotton bales stored on both floors; and the water from hose streams filled the basement where bales of wool were stored. The fire started to spread down an outside platform toward Sections 1, 2 and 3, but four sprinklers of those in service under the platform roof opened and barred the way. In Section 6, as a precaution, the sprinklers which had fused in the previous fire were turned on and allowed to operate for five hours.

Again the firemen worked all night. The next day they had three hose streams in use, and continued to use hose streams intermittently for several days afterward, as fire still smoldered in the cotton bales particularly, and while the unusually difficult work of salvage was organized and carried on.

Salvage Operations.

About 1100 bales of cotton were burned and about 1400 more were wet. Burned bales were in one half of Section 6 and in Section 5. Wet bales were in the other half of Section 6 and in Section 3, where water reached the bottom tiers after flowing in through doorways in spite of earthen dikes hastily put in place during the fire.

In Section 6 the fire flashed over one pile of jute but did not penetrate it to any extent. The remaining jute in this section was badly wet. In Section 4 the fire penetrated deeply into the high pile next to the outside wall, but did not penetrate individual bales. There was a small amount of burning on the surface of the jute pile in the other half of Section 4.

Even under the best conditions, salvage after a fire of this kind is a large-scale operation requiring personnel quickly available and well organized, and facilities for handling the bales. Smoldering cotton bales must be removed one by one and the fires extinguished, and jute should be dried as promptly as possible to prevent weakening the fibre. A public warehouse generally cannot

quickly provide the necessary men, as can an industrial plant which stores its own material.

In this case multiple ownership of the various storage piles and the necessity of obtaining releases also caused delay. The loss of identification necessitated the formation of pools of stock and the agreement of numerous interests on salvage procedure and on division of expenses and proceeds. The precarious condition of walls and roof and high jute piles meant special equipment and extensive shoring before it was safe for men to work inside the building.

Conclusions.

One of the outstanding lessons of this fire is that an ample and clear space is needed between jute storage piles and warehouse walls. Jute bales are made up by placing loose bunches of fibre—known as "hands"—in a baling press and compressing them. A loosely woven but strong jute rope is used to tie the bale. When the bale is wet it expands *in one direction only*—the direction from which the compression force was applied. This expansion breaks the rope ties, and the bale mushrooms out, exerting force sufficient to push out brick walls if space is not provided.

Another serious condition was the location of the power outlet in close proximity to the bales of cotton, in a location where, if arcing did occur, a fire would be almost sure to start and spread rapidly.

The spread of fire from one section to another shows the danger there is in having doorways in walls between sections of warehouses of this kind, even though protected by fire doors.

This fire also strongly emphasizes the undesirable storage conditions which result when piles are too high, with too many bales in a single pile, and too much stock stored in a single fire section.

Sprinklers did an excellent job in view of the adverse conditions under which they operated. They protected the roof and prevented fire from reaching most of the stock in Section 6. They saved the Section 4 roof until the wall was overturned and piping broken. They kept fire from getting a foothold in one of the large piles in Section 4. They prevented fire from entering Section 3. And they kept the second fire from coming out of Section 5 and sweeping down the platform.

The need of restoring sprinkler protection promptly after a fire was never better illustrated. Practically all the damage of the second fire could have been prevented if sprinklers in Section 5 had been restored in time.

Fire Extinguisher Demonstrations.

By P. W. Eberhardt,
Walter Kidde and Co.

When fire strikes in your plant it is of first importance that your men kr.ow exactly what to do and what not to do. You must have men who understand fire and who understand fire fighting.

A few years ago in a Brooklyn plant employees had the habit of heating a certain type of lacquer in a big spoon over an open flame. One day the expected happened. The lacquer flashed. The frightened worker dropped the spoon and jumped out of danger. In a few seconds the blaze was well under way.

There was not one person in the entire factory room who knew what to do! No one touched a fire extinguisher. Not a person made a move toward the blaze. There was a sudden rush for the exit. Seven lives were lost and the plant was a total loss.

All because no one had been told what to do.

If the employees in that Brooklyn factory had known the first thing about fire protection, they never would have dared heat a flammable liquid over an open flame. If they had known the first thing about fire-fighting, someone would have grabbed the nearest suitable extinguisher and smothered the blaze without hesitation.

Thus a fire demonstration, first of all, gives *knowledge* to your workers. By watching and listening they get the *know-how* of handling extinguishers and the *know-why* of fires.

Equally important, your men get the right kind of confidence from this knowledge. After they have seen extinguishers in action . . . after they know how and how not to use extinguishers, they have the confidence to look fire in the eye and knock it down with an extinguisher.

Lectures and moving pictures are good, but there is no substitute for demonstrations. They give the finest training a man can get.

Frequency of Demonstrations.

Stage your demonstrations at least once a year, and preferably twice a year.

If you have a big plant, you should have key men in every department who can fight fire competently. Thus, at first you may have to hold a quick training course in which you put on several demonstrations a day for a week or two . . . until every department has been covered.

NOTE: The text of this article has been published in a pamphlet, "How to Teach Fire Fighting," available on request from Walter Kidde & Co., 140 Cedar St., New York, 6, N. Y.

There are practical reasons for demonstrating at least once a year. Adequate protection requires that all extinguishers be checked annually. Some types must be emptied and refilled. Since you must discharge these extinguishers anyway, why not take advantage of the opportunity and discharge them on an actual fire and hold a fire-fighting class while you do it?

Should men attend each demonstration, year after year? Not necessarily. Each worker should see at least *two* demonstrations. After that, tell him he may attend, if he wishes. Don't discourage repeated attendance by anyone. Fire is fascinating to many folks. You can cash in on this interest and end up by getting well-trained fire-fighters throughout your plant.

Who Should Attend Demonstrations?

Ideally, everyone in your employ should attend. If you have a small shop, invite everybody.

If you have too many employees to invite them all, plan to give fire-fighting instruction to *one worker out of every four or five.* Make certain the trained men are properly scattered throughout the factory. Don't train a large group from one unit and omit to train someone from an adjoining crew. See that foremen and assistants, particularly, take the fire-fighting course.

In larger plants do not make the error of having your demonstration audiences too big. Better results can usually be obtained if there are no more than 40 or 50 spectators.

Handling the Demonstration.

Location.

If possible pick an open space where ground is hard and free from grass. On loose, cinder-filled ground there may be a tendency for flammable liquid fires to reflash, and the surface should be rolled if possible. Grass can also cause blazes to reflash. The idea of having a demonstration in an open spot is to prevent adjoining property from catching fire and to take advantage of the wind blowing in one direction. If too close to buildings, you will get wind eddies which may trouble the demonstrator.

Never run any demonstrations indoors.

The Demonstrator.

The man who handles the extinguishers and runs the tests must be a person who is trained in fire extinguishing and who knows something about fire prevention means and methods.

The demonstrator must be expert with an extinguisher because any fumbling tends to create lack of confidence in the fire-fighting equipment. If you don't have such a man, select someone who handles himself well and have him practice on the various test fires until he feels completely sure of himself and has mastered the various tricks of using the equipment.

The demonstrator should be able to answer fire protection questions, because the question-and-answer period often stimulates livelier interest among

the spectators and can be an extremely important phase of the demonstration.

With this in mind, the demonstrator should, after completing the fire test, make it a practice to ask if any of the spectators has any questions to ask.

The demonstrator should have an assistant and this man should also know something about fire-fighting and fire protection. The assistant will make a good understudy and will be able to handle tests on days when the regular demonstrator is absent.

There should also be a crew of three men who can help set up the fires and can remove all flammable substances when each test is completed.

If you can get someone to come out from the audience and help with part of the demonstration, you will find that it increases interest in the fire-fighting show. One experienced demonstrator makes a practice of doing this. As the demonstration gets under way, he watches the faces of the audience and soon selects one man who appears to be particularly interested, and whose behavior or questions indicate greater-than-normal intelligence. Pick this man to handle one of the simple tests. If he gets it wrong the first time, take advantage of this to explain the mistakes which were made (don't make fun of him), and invite him to repeat the test. You will find that most men can get the fire out in two tries.

The Equipment.

Make certain that you demonstrate the use of each type of extinguisher in your factory.

First of all, make sure that you have sufficient equipment for the tests, plus a reserve of about 50% which will take care of unforeseen circumstances. Make certain that the extinguishers are all charged, inspect seals, check weights, examine hoses for breakage or leakage, and be certain that nozzle openings are clear and free from obstructions.

It is a good idea to line up the extinguishers in orderly fashion to present a well-organized appearance, and be sure that the crew of assistants has a good idea of which extinguishers are to be used on each test.

Don't wait until the last minute to get all of the "props" on hand. Have an ample supply of fuels and containers. Be sure that all test set-ups are ready for the demonstration and locate them so that they can be quickly moved into place.

If you have a portable public address system, it is a splendid idea to have the assistant describe the fire-fighting action while the tests are going on. It makes it much more interesting if he can give this "play by play" commentary and call attention to the tricks which are being used by the demonstrator in extinguishing the fire, and can point out the "do's and don't's" of each unit or each particular type of fire.

Don't get the idea that this is too much trouble; it may be the means of saving your plant from a disastrous fire. And a little care in the presentation will impress your men with the importance of the subject.

Rules Which Apply to Any Demonstration.

1. Always run your demonstrations outside in the open—never indoors.
2. Always have a surplus number of extinguishers available for emergencies.
3. Inspect all extinguishers, as described hereafter, before the demonstration.
4. Caution the spectators that you—not they—will make the test set-ups. If they want special tests they should consult you.
5. Advise spectators to always stand from 15 ft. to 20 ft. away from the set-ups.
6. Extinguish each fire before proceeding to the next one.
7. Beware of reflashes.
8. Don't apply discharge too close to liquid surfaces.
9. After you are through with each set-up, pan, tub, etc., remove them to one side, where the spectators won't have access to them.
10. After your demonstration, remove all excess liquids, etc., used in the test by either taking them away or burning them up. If you burn them up, make certain you have an extinguisher handy with which to control the fire if required.
11. Above all things—know what you are doing and do it competently.

The Demonstration.

Part 1 — What Is Fire?

Start the demonstration by explaining what fire is. The following is a simple and easily understandable explanation:

"In order to have a fire you need three elements—(1) a combustible material, (2) high temperature, and (3) oxygen.

"Take your cigarette lighter as an example of how this works. The material is the *fuel;* the high temperature is provided by the spark from the flint; the oxygen comes from the air.

"Now, you must have *all three* of these element if you are to have a fire. To put it differently . . . if you take away any one of the three, you can't have a fire. Let's go back to the cigarette lighter to show this. Take away the fuel and you can't have a fire, even though the flint works o.k., even though the wick gets plenty of air. Take away the flint (the thing that makes the temperature) and you cannot get a light. In other words—no fire. Take away the air by lowering the cap over the burning wick and the flame goes out. No oxygen—no fire."

Part 2 — Extinguishing the Fire.

Here it is a good idea to have a few simple "props." A demonstration table which need not be bigger than a card table, on which the props stand; glass of water; 2 pie tins, or small pans; a skillet lid which is big enough to cover the pan; handful of excelsior; cupful of gasoline.

Now the demonstrator can say:

"You can fight fires successfully by taking away any one of the three elements mentioned before.

"It may sound silly to say that you can stop a fire by taking away the material that's burning. However, that makes good sense, and you may get a chance to do it some day. It's a very effective way of putting fire out. Suppose a pump is throwing oil into a room from a broken connection. Well, wouldn't you shut off the pump, first thing? Or, if excelsior catches fire beside an open window, and if you had a shovel, wouldn't it be a good idea to scoop up the burning pile and dispose of it? In these cases you would be simply removing the material.

"How do you remove the temperature from a fire? By cooling the blaze, usually with water. (Now light the handful of excelsior on one of the pans. Then pour the glass of water on the fire.) That fire went out because the water cooled the excelsior below the ignition point.

"How do you remove oxygen? You read of people's clothing catching fire and the standard way of killing the fire is to roll them in a rug or blanket. That's simply a way of removing the oxygen. See how it works with burning gasoline. (Pour gasoline into another pan. Throw match into it. Now pick up

the skillet lid and drop it over the pan so it shuts off the air. Remove the lid.)

"The fire's been extinguished by smothering, by removing its oxygen supply. Sometimes one of you men may get a chance to smother a fire by throwing some kind of blanket over it. But remember it may be a blanket of gas from a carbon dioxide extinguisher or from a carbon tetrachloride unit. And when you fight fire this way you are merely removing the fire's supply of oxygen."

Part 3 — Classifications of Fires.

"All fires don't behave in the same way. What works on one fire may not work on another fire. And what I am going to say now is the most important part of this fire-fighting class. Remember these very simple facts . . . and you've got the basis of understanding fire and how you fight fire.

"There are three general classes of fires:

"CLASS 'A' FIRES are fires in ordinary materials, such as wood, paper, textiles, rubber, excelsior, rubbish, and so forth. You extinguish these fires by *quenching* them with water, or with extinguishers which use large percentages of water.

"CLASS 'B' FIRES are fires in flammable liquids, greases. You put these fires out by blanketing or smothering them.

"CLASS 'C' FIRES are fires in live electrical equipment. The important thing here is to use an extinguishing agent which does not conduct electricity.

"Try to remember that Class 'A' fires are the ordinary fires, that Class 'B' fires are flammable liquids and grease fires, and that electrical fires are Class 'C.' If you do remember these letters 'A,' 'B,' and 'C,' it will help you pick the right fire extinguisher, in case you forget which extinguisher is which.

"Here is how it helps. In this plant we use only fire extinguishers which have been tested and approved by Underwriters' Laboratories, Inc. When the Underwriters put their o.k. on an extinguisher, they tell you what that o.k. means. They tell you if it is o.k. for Class 'A,' Class 'B' or Class 'C' fires, and they tell you right on the extinguisher itself. Every approved extinguisher has the Classification marked on it. Look at the label and the Approval Notice and you'll see 'Classification B-2, C-2,' or 'Classification A-1, B-1,' or something like that. If you see the letter 'A,' or 'B' or 'C,' then you know the extinguisher is o.k. for those types of fires. When in doubt, look at the label and find the 'Classification Notice.' "

Part 4 — The Fire Extinguishers.

In demonstrating the use of various extinguishers it is well to follow a definite plan of order. For example, it is logical to show the water-type units first, then vaporizing liquid, then dry compound, then carbon dioxide units. Don't jump around from one type to another and then back to the first type again.

Don't let the demonstration get *competitive*. Don't try to show up one type against another. If you do, and one extinguisher beats another in the competition, then the men who have the "losing" extinguisher in their department will have lost confidence in that particular unit.

However, don't hesitate to demonstrate the futility of trying to use the wrong extinguisher on a given fire. You might, for example, show how well a soda-acid unit kills an excelsior fire. Then show it used against a gasoline pan-fire. Tell the audience beforehand that it doesn't work against the gasoline fire. After it has failed to extinguish the blaze, point out that the soda-acid unit is still a fine fire-fighter. You have simply misused it . . . like trying to play billiards with a baseball bat. The bat is a fine thing for baseball, but no good on a billiard table. The soda-acid extinguisher is excellent for Class "A" fires . . . but not recommended for Class "B" or "C" fires.

1 LIFT OFF WALL HOOK
2 CARRY TO FIRE IN UPRIGHT POSITION
3 INVERT AT SCENE OF FIRE
4 AIM WATER OR FOAM STREAM AT BASE OF WOOD FIRE; FLOAT FOAM ON FLAMMABLE LIQUID FIRE

Soda-Acid Extinguisher.

How It Works.

The extinguisher contains a solution of bicarbonate of soda in water. A cage holds a small bottle of sulphuric acid in the neck of the extinguisher. When you turn the unit upside down, you mix the acid with the soda solution. The chemical reaction forms a gas which forces the water from the extinguisher.

It makes the demonstration more interesting if you show what happens when the acid mixes with the soda solution. To do this, unscrew top and lift out the acid bottle. Pour acid into extinguisher and watch reaction. Wear rubber or heavy work gloves to prevent acid burns when handling bottle.

Method of Use.

Demonstrate the correct technique (see illustrations). Grasp hose in right hand and hold the ring-top with the same hand. Left hand supports the bottom. Carry extinguisher to fire and invert. Hold extinguisher with left hand by carrying handle located inside base of unit. Hose is held in right hand.

Explain that extinguisher should never be inverted until you are ready for fire-fighting.

The Test Fires.

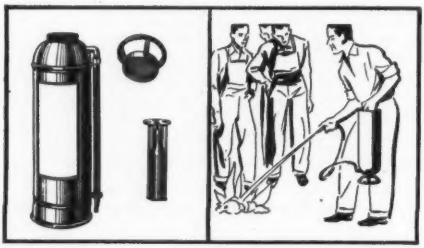
Wood, paper, shavings, excelsior all make adequate test fires.

Fighting the Fire.

Aim extinguisher stream at base of blaze; keep wind at your back; scatter embers when fire is out, to prevent rekindling.

Approved Use.

Point out that soda-acid units are approved for use on Class "A" fires only. Range is 30-40 feet. Discharge lasts about 1 minute for 2½-gallon size.



Water Extinguisher.

How It Works.

The extinguisher itself contains pure water. Cradled in a cage in the neck of the extinguisher is a small bottle of carbon dioxide. When you invert the extinguisher and bump it on the ground, you pierce the cap of the carbon dioxide cartridge, releasing the gas. This creates internal pressure which expels the water.

Note—Neither the water-type extinguisher nor the soda-acid unit is a "chemical" fire extinguisher. The stream is primarily water, and nothing added to the stream has any appreciable effect on the fire-fighting ability of the extinguisher.

Method of Use.

Remove extinguisher from bracket, following the same technique as with the soda-acid unit (grasp hose in right hand and hold ring-top with the same hand. Support bottom with left hand and carry to fire). Invert the extinguisher and bump it sharply on the ground or floor.

The Test Fires.

Wood, paper, shavings, excelsior and other common substances.

Fighting the Fire.

Aim extinguisher stream at base of fire. Keep wind at your back. Be sure to scatter embers after blaze has been apparently extinguished.

Approved Use.

Water-type extinguishers are approved for use on Class "A" fires only. Range is 30 to 40 feet. The 2½-gallon unit's discharge lasts for approximately 1 minute.

Loaded Stream Extinguisher.

How It Works.

The loaded stream extinguisher is similar in principle to the water-type unit. There is a gas cartridge which, when punctured, expels the contents.

However, the loaded stream unit utilizes an extinguishing solution containing alkali metal salts and which produces a unique fire-fighting reaction. On Class "A" fires there is a fireproofing effect. Moreover, the loaded stream units can be used on Class "B" fires.

Method of Use.

Turn extinguisher upside down and bump on floor or ground. Carry unit to blaze by same method as prescribed for soda-acid and water-type units.

The Test Fires.

On Class "A" fires, use similar tests to those suggested for soda-acid and water units. To illustrate extinguishing action on Class "B" fires, the manufacturer suggests a spill-fire on a hard, level surface, drenching an area 4 or 5 feet square with 1 or 2 quarts of oil.

Fighting the Fire.

Attack the blaze in same way as recommended for soda-acid and water extinguishers.

Approved Use.

Approved for Class "A" fires and Class "B" spill-fires. Range is 30 to 40 feet. Time of discharge is approximately 1 minute for 2½-gallon unit.

Dry Compound Extinguisher.

How It Works.

The dry compound extinguisher contains chemically processed bicarbonate of soda. An inner cartridge, loaded with carbon dioxide or nitrogen, is released when a turn of the hand-wheel punctures the gas cartridge.

Method of Use.

Turn the hand-wheel to break the seal of the carbon dioxide cylinder. Valve on nozzle controls discharge.

The Test Fires.

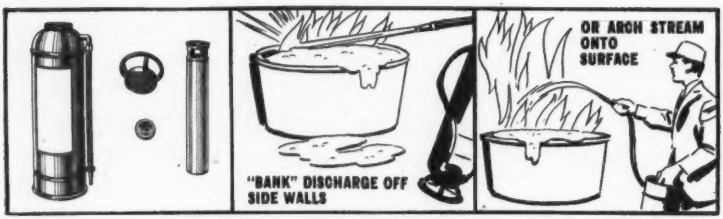
For 7½-lb. unit, use same fires as listed on page 51 for Trigger Control models. The 12- and 20-lb. units can use the same fires as recommended for 10- and 15-lb. carbon dioxide extinguishers.

Fighting the Fire.

Aim discharge at base of blaze. Walk around fire.

Approved Use.

Approved for Class "B" and Class "C" fires. Range is 10 feet for 7½-lb. extinguisher and 14 feet for 12- and 20-lb. models. Discharge of 7½ pounder lasts about 15 seconds; 20 to 25 seconds for 12 pounder; 40 to 45 seconds for 20 pounder.



Foam Extinguisher.

How It Works.

It is not advisable to go into the complicated chemical formula which underlies the principle of the use of foam. It is best to explain simply that the extinguisher usually contains a solution of bicarbonate of soda in water, plus a foam stabilizing agent. Within a smaller container in the neck of the extinguisher is a solution of aluminum sulphate. When the extinguisher is inverted, these two solutions mix and produce a foamy substance consisting of carbon dioxide gas confined in tough, durable bubbles.

At this point the demonstration is made very much more interesting if you show your audience what happens when the two solutions come together.

Take a tumbler containing a quarter of a glassful of the aluminum sulphate solution from the inner chamber of a foam extinguisher. Pour this into a larger vessel containing a glassful of the sodium bicarbonate solution from the outer chamber of a foam extinguisher. Then invite the audience to come up close to the demonstration table and look at the foam blanket which is produced.

Method of Use.

Here again you follow the same technique as with the preceding extinguishers. It is well to emphasize that by using this technique you don't get the hose in the wrong hand; you are ready to fight the fire, and it is by far the easiest way to use the unit. Carry the extinguisher to the fire and invert it.

The Test Fires.

While foam can be used to extinguish Class "A" fires, its most interesting application is on flammable liquid blazes. Use a wash tub, 20 to 24 inches in diameter. Pour in two gallons of gasoline. (When lighting any flammable liquid, it is best to use a long-handled torch. If you use a match, don't stand too close.)

Fighting the Fire.

Explain to your audience that you are trying to build up an unbroken blanket which will cover the burning surface. For that reason you will "bank" the extinguisher stream off of the inside wall of the tub, so as to permit the natural spread of the foam back over the burning surface.

If you have many foam units in your plant, repeat this test and stand far enough away from the fire to arch the stream so that the foam falls lightly on the burning surface. If possible, walk around the fire while directing the stream so as to get maximum coverage.

Point out during all of these tests that your object is to avoid agitating the foam blanket, which allows air to get to the fire.

Approved Use.

Foam extinguishers are approved for Class "A" and Class "B" fires. The range is 30 to 40 feet, and the time of discharge for 2½-gallon and 5-gallon units is approximately one minute.

Vaporizing Liquid (Carbon Tetrachloride) Extinguisher.

How It Works.

The vaporizing liquid unit expels a liquid which is vaporized into gas by the heat of fire. It is the gas which does the fire extinguishing.

Most vaporizing liquid extinguishers are of the pump type which is familiar to your audience. There is also a stored-pressure type.

Method of Use.

The pump-type extinguisher is usually held in a bracket which clamps the shoulder of the extinguisher and allows the base to rest in a socket. Grasp the handle and pull outwards. Carry to fire with right hand on handle, left hand holding nose of extinguisher. Unlock the handle, by turning, while approaching blaze. Pumping expels the liquid.

Test Fires.

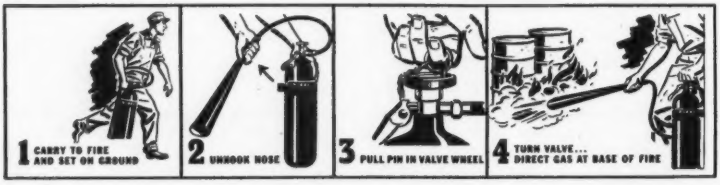
Spill about one quart of gasoline on the ground over an area 1½ feet by 3 feet. Take a small, deep pan. Put a quart of gasoline in it.

Fighting the Fire.

Aim stream at the base of the blaze. On the spill-fire work from the narrow end on the windward side and progress slowly down the long side of the fire. On the small tub fire, repeat the trick of hitting the wall of the container slightly above the liquid surface. This has the advantage of breaking up the stream and accelerating the vaporization. Walk around the fire to get maximum coverage.

Approved Use.

Vaporizing liquid extinguishers are approved for use on Class "B" and Class "C" fires. Range is 20 to 30 feet. The discharge of the one-quart unit lasts for about 45 seconds; for the 2-quart unit, approximately 150 seconds.



Carbon Dioxide Extinguisher.

How It Works.

The extinguisher holds liquid carbon dioxide under pressure of 850 lbs. per square inch. When the extinguisher valve is opened, the pressure is released. The liquid carbon dioxide, upon contact with the air, turns into gas which has a blanket effect on fires. It dilutes the oxygen supply, doesn't allow the blaze to breathe.

Method of Use — Trigger Control Model.

Hold pistol grip in right hand; with left hand swing the nozzle arm to horizontal position, pull trigger.

On 10- and 15-lb. Units.

Grasp nozzle by handle and pull out of clamps which hold it to side of extinguisher, holding nozzle in left hand. Carry extinguisher to fire by means of carrying handle. Place on ground, remove locking pin and open valve with right hand.

Wheeled Units.

Free the hose so that it will not kink or tangle. Making sure the control valve on the nozzle handle is closed, open the release valve located on the cylinder. This enables you to control discharge of carbon dioxide at the nozzle as you fight the fire. To operate, open the control valve located at end of nozzle handle.

Vertical panel test fire. Gasoline supply container at upper left provides fuel for blaze, which is being extinguished with a wheeled carbon dioxide unit.

Test Fires — Trigger Control Model.

Spill a quart of gasoline on the ground over an area of 1½ feet by 3 feet. Or use a shallow pan of 1 sq. ft. area, containing gasoline.

15-lb. Unit.

Take 2½ gallons of fuel oil and one to two gallons of gasoline. If the ground is soft, use two gallons. If the surface is hard, one gallon will give you a good fire. Spill this on the ground in a line approximately 2 to 2½ feet wide and 8 to 10 feet long.

Running Gasoline Fire.

Take a 3- to 5-gallon pail (*not soldered*). Punch 4 holes in the bottom with an ice pick. Suspend the pail 2 to 3 feet off the ground by a tripod stand made of pipe. Pour in 3 gallons of gasoline and ignite immediately.

Wheeled Units.

Take five gallons of fuel oil and 3 gallons of gasoline and spill them over ground covering area 4 ft. by 15 ft.

If you want a really spectacular fire-test to end your demonstration with a smash hit, show the men how a 100 lb. wheeled unit attacks a vertical panel blaze. Erect a galvanized iron panel 12 feet in height by 4 or 5 feet wide. Across the top edge of the panel fasten a length of perforated 1-inch pipe, running the full width.

The perforated piping is supplied from an open-top steel 5-gallon gasoline can fifteen to twenty feet distant and a few feet higher than the panel. This can be done by building a small platform on which the gasoline supply can will rest. The flow of gasoline is controlled by a valve close to the supply can, and closed piping runs down to the perforated piping which tops the vertical panel.

Open the control valve, allowing the gasoline to run into the perforated piping on the panel. After the gasoline has flowed down the face of the wall for a few seconds ignite this "waterfall."

Fighting the Fire.

Aim discharge at base of blaze in all cases. When using the trigger-control model on the small pan fire, call attention to the gentle discharge which doesn't agitate the burning surface and cause the blazing liquid to spill out, endangering other near-by flammable substances.

Extinguish the spill fires in the usual way, starting at the short side and advancing down the length of the fire with the wind at your back.

The running fire (from the leaking bucket) may take some practice, but it will not be difficult to handle if you extinguish the ground fire first, with the horn pointing downward so that the discharge falls through the burning stream of gasoline coming through the perforations in the pail. When the ground fire has been extinguished, quickly discharge gas into pail.

Another way of doing this is to extinguish the ground fire first, then swing the discharge up the burning stream and into the pail in one quick movement. In this way you "erase" the running stream as you raise the carbon dioxide discharge.

With wheeled units you fight the spill fire in the ordinary way—hit base of blaze, wind at back, etc. Swing the nozzle slowly from side to side so that the whole fire area is blanketed.

On the vertical panel fire, remember to fight this blaze from the bottom up. Kill the ground fire first. Then, in a side-to-side motion, direct the discharge slowly up the wall. Don't try to work too fast. If you are fighting this fire in a wind, you may have to be patient, because a gust will often swirl the flames around and re-ignite the lower portion of the set-up. Then go back and start at the bottom all over again. If you have to do this 2 or 3 times, don't worry. The audience can see that this one is a hard-to-handle fire and they'll be rooting for you. Working deliberately, follow the flames up the wall with the carbon dioxide discharge. Before you know it, the blaze will be extinguished . . . a grand finale to your fire-fighting show.

In demonstrating carbon dioxide units there are some interesting tricks which you can employ. When you have extinguished a fire, turn the discharge on to the sleeve of your coat or on your trouser leg. Your suit will be coated with carbon dioxide snow which slowly evaporates into thin air. You can explain that this demonstrates the *harmlessness* of carbon dioxide. In other words, it will not contaminate chemicals or solutions which are being processed.

On the running fire, explain that it is the three-dimensional fire-fighting action of carbon dioxide that enables it to kill this extremely difficult blaze.

Point out too that the fast expansion of the discharge, which is shown by the way the gas billows as it comes out of the nozzle, enables the carbon dioxide unit to reach fires which are hidden behind obstructions.

Approved Use.

Carbon dioxide extinguishers are tested and approved for use against Class "B" and Class "C" fires. Range is 3 ft. for the 2-pounder and discharge lasts approximately 20 seconds. With the 15-pounder the fires are 6 feet and about 45 seconds.

Conclusion.

It is strongly recommended that each person who sees the demonstration be given a permanent record of what he has seen and heard. Therefore, it is advisable to provide the audience with mimeographed sheets which summarize the lecture and the demonstration. These sheets should explain the three elements of fire and the differences between Class "A," "B" and "C" fires. They should explain the various extinguishers and the types of fires for which they are approved.

One way of keeping interest at a good high pitch is to have one of the demonstration staff carry a stop-watch and time the extinguishing of each fire. After the fire has been put out, announce the time of extinguishment and invite the audience to note it on their "score cards."

Always encourage questions. After you have finished extinguishing a fire, don't go on to the next one until you are sure everyone understands what has just been demonstrated. Be willing to repeat test fires if requested.

Once you have started your program of periodic demonstrations, don't let anything interfere with your schedule. Decide how often the demonstrations will be held, mark your calendar or establish a tickler file, so that you strictly hold to a regular schedule of well-planned and instructive fire-fighting classes.

Some day one of your pupils may save your plant for you!

Tire Recapping Shops.

For the duration tire recapping has replaced retreading, and is a sizable industry. The fire record shows that it is often conducted in small shops, which all too frequently are operated by men lacking appreciation of the importance of fire prevention measures, which commonly lack automatic sprinkler protection and which in some instances do not have any fire extinguishing equipment. In general, the hazards are better safeguarded, and better fire protection is provided in the shops operated by the larger concerns that have been in the business over a period of years.

The most likely source of fire is at the buffing machine, where the rubber is buffed off the tread by means of a small motor driven cylinder, usually about 3 inches long and 10 inches in diameter. This cylinder is studded with steel points which protrude about one-quarter of an inch. The cylinder is connected by a shaft about one and a quarter inches in diameter to an electric motor of at least five horsepower.

The tire to be buffed is set in an appropriate sized form, which fits into a permanent part of the buffing machine, so that the tire contacts the buffer in a horizontal position. The tire is moved vertically up or down, or horizontally to the right or left by turning one of two wheels for the desired operation. This preliminary buffing operation for recapping a tire consists in removing the original tread approximately two-thirds of the distance from the center outward on both sides. To "retread" a tire, as understood before the war, required the removal of all of the original tread. Retreading, as a usual practice, is out for the duration.

It is essential that as the rubber dust is produced in the buffing operation it be removed immediately through an effective exhaust system with suction inlet at the buffer, otherwise a chance spark caused by the contact of the steel points against some foreign material in the tire might cause an explosion or fire. The best practice dictates the installation of a system which carries the dust to an enclosed receptacle outside the building. Partitioning off the buffing operations in a room apart from the rest of the recapping processes also lessens the hazard of suspended dust.

In the buffing operations some of the buffed-off rubber is too heavy to be sucked into the ventilating system. This rubber drops to the floor directly under the machine. While it is too heavy to float through the air, it nevertheless is a fire hazard if allowed to accumulate. It should be removed at frequent intervals.

When the tire has been buffed it is ready to have rubber cement applied by brush to its buffed surface. After the cement is thoroughly dried, a strip of

rubber of appropriate width is applied by hand. These strips come from the manufacturer in various widths, and are made entirely from reclaimed rubber for repairing passenger car tires, and from a mixture of reclaimed with crude rubber for truck tires. The fire hazards in handling rubber cement depend upon the solvent used, but since in any case the flash point is considerably below ordinary room temperature there is always considerable danger of fire. Ordinarily this cement is purchased in five-gallon cans. Dipping a brush into an open five-gallon can of rubber cement is not a safe practice. The safest practice is to expose no more cement to the air than is sufficient to brush a few tires, and to keep reserve supplies outside the room.

When the rubber strip has been applied the tire is ready for insertion into the appropriate sized mould, after an inflated, specially constructed, rubber tube is inserted. These moulds are castings. Part of their structure is the matrix (pattern) made of steel or aluminum, which is impressed into the recapping material under a steam pressure of 150 to 200 pounds per square inch at 250 to 300° F., depending on the size of the tire. At this temperature and pressure, which is maintained for from one to three hours (depending on the thickness of the rubber strip), the strip unites with the adjacent portions of the tire and carcass, bearing the impress of the matrix as its new tread. Upon removal it is a recapped tire. The boiler supplying the steam should be located outside the building that is devoted to the recapping operations.

There are many jobs where only a section of the tire needs to be repaired, *i.e.*, where the tire has been cut or bruised in one or more spots or sections. In cases where the tire carcass has been penetrated, it is necessary to rebuild the inside with as many ply fabric as has been destroyed. The outside of the tire is repaired by cutting the tread stock to the proper size and, if necessary, building the tire up with fabric so that when the tread stock is cemented in place a smooth job will result. That portion of the tire that has been repaired now goes under the heat and pressure process in specially constructed moulds, where the repaired portion unites with the adjacent portions of the tire. After the tire is removed, the treads on the repaired portion are remade as nearly similar to the original as a hand operated electric knife can make them. The principal fire hazards in using the electric knife are defective wiring, and chance sparks igniting suspended dust.

Observation of the housekeeping methods in many of the smaller tire recapping shops discloses little regard for good fire prevention practices. Accumulated rubbish, inadequate or no exhaust system for removing suspended dust, poorly installed and maintained wiring systems, and too few fire extinguishers are all too common. The better shops have an adequate complement of extinguishers of the soda-acid and foam types. Prohibition of smoking and elimination of any open flame devices from the vicinity of the operations are obvious precautions.

Mercury Herald.

Fire occurred in this tire retreading shop in San Jose, California, on May 8, 1942. The proprietor had closed his shop for the night five minutes before fire was discovered. He said he had no idea how it started.

The length of life of a recapped tire depends on so many different factors that no definite mileage can be guaranteed. The better shops utilized on government business state that a recapping job on truck tires should give from 60 to 75 per cent additional mileage, and on passenger cars from 35 to 50 per cent additional mileage as the tire delivered before recapping under the same conditions of driving.

Recent fires in recapping tire shops as reported to the National Fire Protection Association are listed below, together with the causes and the amount of property loss, when known. Undoubtedly many other fires have occurred which have not been reported to the N.F.P.A. Department of Fire Record.

Typical Fires in Tire Recapping Plants.

FEB. 18, 1942, HAVERHILL, MASS. Fifteen hundred tires were destroyed when fire started in the buffing room from a spark from recapping apparatus. Building, of one-story concrete construction, and its contents were badly damaged. Flames spread rapidly due to combustible wall and ceiling construction. Loss $3400.

MAY 8, 1942, SAN JOSE, CALIF. Fire caused by an overheated bearing on a buffing machine destroyed a tire recapping plant and supplies of new and used tires. Large quantities of buffing dust strewn over the floors contributed

This fire in a tire recapping plant at Easton, Pa., on June 11, 1942, was attributed to the use of an acetylene torch in removing a steel beam. In addition to the tire recapping equipment, a large quantity of scrap rubber and recapping material was lost. No automatic sprinklers or other adequate protection were provided and the alarm was delayed while employees made ineffectual attempts at fire fighting. The folly of using such a building for this occupancy should be self-evident.

Mercury Pictures.

Firemen are shown battling a $50,000 fire which raged through this tire recapping shop in Hammond, Ind., on April 16, 1943. Sparks at a buffing machine ignited suspended rubber dust and the whole plant was involved on arrival of the fire department.

Mercury Pictures.

Ruins of the Hammond, Ind., tire recapping shop after fire swept through. Lack of a dust collecting system, wooden interior construction, storage of rubber cement and solvents in the main room, and lack of any private protection were factors contributing to the heavy loss.

to the rapid spread of the flames. No sprinkler protection or first-aid fire fighting appliances were provided in this one-story brick and frame building. Loss $13,000.

JUNE 11, 1942, EASTON, PA. Sparks from an acetylene torch used in removing a steel beam resulted in a fire which destroyed an ancient four-story frame building with its contents, which included a stock of scrap rubber valued at $30,000. All of the recapping equipment was lost. Alarm was delayed while employee tried to extinguish the blaze with buckets of water. No private fire protection or automatic sprinklers were provided.

JUNE 17, 1942, WATERLOO, IOWA. Fire of unknown cause originated in a tire recapping shop and entered the loft space. The one-story brick structure contained six occupancies separated by division walls which did not extend through the loft. Flames easily communicated to the other five shops by way of the roof. Loss $26,500.

SEPT. 25, 1942, HENDERSON, TEXAS. Fire of undetermined origin destroyed automobiles, tires, trucks, recapping machinery and tools, and about a ton and a half of rubber. Entire shop was in flames when the fire fighters arrived at the scene. Loss estimated at $75,000 to $100,000.

OCT. 1, 1942, NASHVILLE, TENN. Automobile tires and accessories were destroyed when fire, believed caused by defective wiring, started in the vulcanizing room. There were no fire walls in the three-story brick and frame building. No automatic sprinkler protection or watchman service was provided. Loss estimated at $100,000.

DEC. 28, 1942, JAMESTOWN, N. Y. Several thousand tires were destroyed by fire of unreported origin. Loss unknown.

JAN. 6, 1943, PHILADELPHIA, PA. Fire of unknown origin started in a rubber storage warehouse and recapping plant under a bench in the room used to build up the fabric on bruised or cut tires in the recapping operations. One of two men working on the moulds on the night shift saw a reflection of fire over his shoulder. It traveled with great speed over the entire floor devoted to recapping, 80 x 150 feet, and thence to the entire building. Delay in sending in the alarm made it impossible to salvage 3000 new and recapped tires. Loss estimated at $200,000. No sprinkler protection.

FEB. 17, 1943, NORTH KANSAS CITY, MO. Fire of unknown origin from waste paper in a rubber storage warehouse and recapping plant at 1 A.M., and reported in an alarm by a workman in the tire recapping department, resulted in the total loss of the building and its contents. There was no watchman service and no sprinkler protection. It appears that this is another case of a delayed alarm, for when the local fire department arrived the building was beyond salvage. Estimated loss $500,000.

MARCH 9, 1943, PITTSBURGH, PA. A tire recapping shop was operated in the basement of a four-story brick building with interior wooden construction and open stairways. Thirty gallons of butane were stored on the premises in violation of a city ordinance, according to the chief of the fire department. The fire, discovered early in the evening by a passing pedestrian, extended to an adjoining restaurant, but was controlled by the fire department with a loss of $6000.

APRIL 16, 1943, HAMMOND, IND. Sparks at buffing machine ignited suspended rubber dust in an auto sales and service garage, which had recently been converted into a tire recapping shop since the last fire department inspection, and without the knowledge of the building department. The entire working floor of building was involved in flames upon the arrival of the fire department, who devoted their main efforts to saving adjacent property. The enclosure used as a buffing room was constructed of two by fours and covered with paper board. There was no dust collecting system. Rubber cement and solvents were stored in the main workroom. There was no private fire protection of any kind. Seventy per cent of the building and 80% of its contents were destroyed. Estimated loss $50,000. In the opinion of the chief of the fire department a bucket of dry sand could have saved the entire plant if used intelligently at the start of the fire.

MAY 28, 1943. CINCINNATI, OHIO. Heat from a chimney ignited a wooden beam, and fire burned for some time before discovery by a passer-by, who noticed smoke and gave the alarm at 10:30 P.M. A considerable stock of used and recapped tires was involved in the brick-walled, wooden interior building. The damage was limited to less than $1000 through efficient fire fighting and salvage work. No fire appliances in the building.

Carbon Tetrachloride on Magnesium Fires.

The U. S. Bureau of Mines has released a Report of Investigations, dated February, 1943, under the title "Application of Carbon Tetrachloride-Type Fire-Extinguisher Liquid to Burning Magnesium Chips and Magnesium Incendiary Bombs."* With the advent of the magnesium incendiary bomb and the expanding use of magnesium and its alloys in the manufacture of airplane parts, the Bureau was urged by the Chemical Warfare Service and the Office of Civilian Defense to sponsor the investigations.

More than fifty tests were made on wood, concrete and steel bases. They were designed to determine (1) whether the toxic gas phosgene is formed and (2) whether other significant gases are formed under the same conditions. These tests were conducted co-operatively by personnel of the Bureau of Mines and representatives of the Chemical Fire Extinguisher Association (Member N.F.P.A.).

The Bureau states in the report that "the extinguisher industry and others had generally agreed that carbon tetrachloride liquids should not be used to extinguish burning magnesium or thermit-magnesium incendiary bombs. This statement would hold regardless of whether or not dangerous quantities of noxious gases were formed, because the reaction between the extinguisher

*The extinguishing liquids employed in these tests and all others mentioned in this article were taken from cans filled for the market by manufacturers of carbon tetrachloride extinguishers, not commercial carbon tetrachloride, which is unsuitable for use in extinguishers.

liquids and the burning magnesium is more violent than that of water without the wetting of surrounding materials, which is an important factor in the use of water. However, such fire extinguishers are in widespread use, and if a burning incendiary bomb should ignite adjacent materials it might be expedient to use an extinguisher of this type to control this secondary fire, provided that incidental contact between the liquid and the bomb is not hazardous to the operator."

The essence of the report is highlighted when the parts per million (by volume) of the toxic gases found in the tested atmospheres, as shown in Table I below, are compared with the parts per million of these gases that have long been known to be dangerous and fatal to man on brief exposure, as shown in Table II.

Table I.

From U. S. Bureau of Mines Report of Investigations 3686.

Range of toxic gases found in parts per million of tested atmospheres, when carbon tetrachloride-type fire extinguisher liquids were applied to burning magnesium chips and magnesium incendiary bombs.

Gas	Range	Range on surfaces of: Wood	Concrete	Steel
Phosgene	0.3 to 16.6	9.6 to 16.5	0.3 to 16.6	1.1 to 4.2
Chlorine	0.9 to 158.0	0.9 to 8.3	27.5 to 58.7	36.0 to 158.0
Hydrogen chloride	0.0 to 14.4	0.0 to 4.9	1.9 to 14.4	0.0 to 9.7

Carbon monoxide was found in all tests but one; in no test greater than one-fifth of 1 per cent, or about the quantity found in ordinary wood smoke.

Table II.

From U. S. Bureau of Mines report, "Poisonous Gases from Carbon Tetrachloride Fire Extinguishers."

Toxicities of Air Containing Gases from Fire Extinguishers (shown in parts per million of tested atmospheres).

	Phosgene	Chlorine	Hydrogen Chloride
Maximum amount that can be inhaled for one hour without serious disturbances	....	4.	50.-100.
Dangerous in thirty minutes to one hour	....	40.-60.	1500.-2000.
Noxiousness, impossible to breathe for several minutes	5.	5.	66.-200.
Toxicity of lethal dose, man, thirty minutes' exposure	25.	....	1000.

The report concludes that the use of carbon tetrachloride fire extinguisher liquid on burning magnesium, or magnesium incendiaries, is not recommended, but its use on fires, whether started by bombs or by other causes, should not be discouraged, as such types of extinguishers are in widespread use and have etablished an excellent record in the control of incipient fires over many years.

Galveston Cotton Storage Fire.

By George F. Rutzler (Member N.F.P.A.),
Cotton Engineering and Inspection Service.

The Cotton Concentration Company, Galveston, Texas, had for some years operated a number of large cotton warehouses. Four of these warehouses, each with a storage capacity of around 50,000 bales, subdivided into separate storage compartments by fire walls, were provided with standard automatic sprinkler protection with three separate water supplies and were generally satisfactory from the fire protection point of view.

In 1942 the storage was expanded by the erection of a new building designated as Plant E, 100 feet from Plant D. The management of the company, fully appreciative of the importance of fire protection, planned to provide automatic sprinklers for the new warehouse and made application to the War Production Board for priority assistance for the sprinkler installation and for additional hydrants, but their application was rejected. The warehouse, nevertheless, was completed, owing to the immediate need of additional cotton storage facilities, and when fire occurred on May 24, 1943, contained

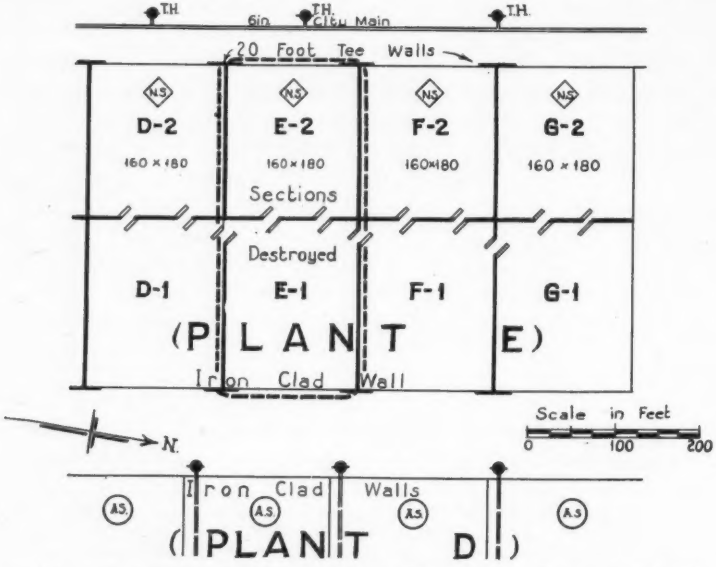
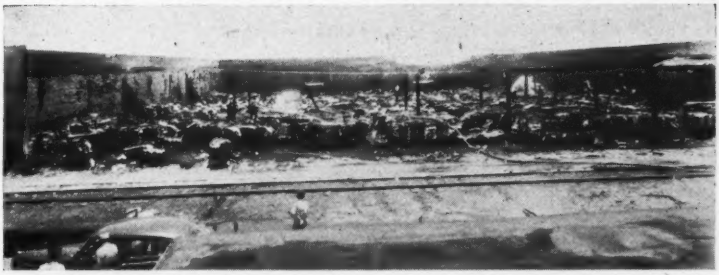


Diagram of part of Plant E of the Cotton Concentration Company, Galveston, showing the area involved by the fire on May 24, 1943.



Looking west at the burned area from the roof of Plant D. The break in the fire wall in the background is where the lightning struck.

Another view of the burned area, showing the character of the damage.

some 50,000 bales of cotton, a large part of it owned by the U. S. government and not insured.

Plant E covered an area of 380 x 1120 feet and was subdivided into fourteen fire sections. Compartments E-1 and E-2, where the fire occurred, were 160 x 200 feet and 160 x 180 feet respectively. The arrangement is shown on the accompanying diagram. Division fire walls were 17-inch interlocking hollow tile supported by strong interlocking tile buttresses faced with hard burned brick. Fire walls were teed twenty feet at ends and parapeted five feet above flat roof line. Both tees and parapets were faced with concrete. Floors were shell with concrete rims and roof was built up composition covered with gravel.

Under ordinary conditions it might have been anticipated that fire could have been confined to one section, but on May 24, 1943, during a severe storm, lightning struck the fire wall between Compartments E-1 and E-2, igniting the cotton stored on both sides of the wall. The watchman immediately turned in an alarm through a private fire alarm system, and the Galveston Fire Department responded promptly. The watchman, however, was unable to make his escape from the fire area, and his body was found in Compartment E-2, not far from the door. The exact cause of his death is unknown.

The fire was fought from the east and west sides of Section E and from the roofs of the adjoining Sections F and D on the north and south sides. Galveston Fire Department pumpers took suction from a six-inch dead-end city main and from private fire hydrants supplied by two 100,000-gallon gravity tanks and provided sixteen hose streams. The water supply was adequate at all times after pumps were put into operation to supply the necessary water to the dead-end main. A very high wind handicapped the fire fighting activities, but at about 3:00 A.M. the wind died down and the blaze was brought under control. The Coast Guard rendered assistance to the Galveston Fire Department.

The tile walls on the north and south sides of the burned area did their job in preventing the spread of fire, but were damaged to such an extent as to require extensive replacement. The fire doors did their duty, closing quickly and keeping the fire from spreading to other compartments.

The cotton was piled with adequate center and cross aisles, permitting the maneuvering of hose lines and the quicker extinguishment of the fire. However, the cotton was tiered six bales high, resulting in a severe fire and decreasing the salvage, as the bales had to be broken down to get at individual bales to extinguish remaining smouldering fires.

There were 8542 high-density bales of cotton involved in Compartments E-1 and E2, of which about 5500 bales were owned by the U. S. government and were not insured. With approximately 30% salvage the total loss on the cotton amounted to $600,000, of which $400,000 was uninsured government-owned cotton. The loss to the building is estimated at $50,000.

Cairo Meal and Cake Company Fire.

On March 31, 1943, fire gutted the Cairo, Illinois, Meal and Cake Company cottonseed and soy bean oil mill and then spread to the adjoining warehouse of the Cairo River and Rail Company. The mill was largely of frame construction, had no fire cut-offs or protection against exposure. Automatic sprinkler protection was provided for three-quarters of the plant, but 90% of the sprinkler equipment was obsolete.

Story of the Fire.

In the early morning hours of March 31 fire originated near the west wall of a cottonseed storage area in sprinklered Section 10 of the mill. The cause was undetermined. Although the plant was in operation at the time of the fire, with ten men processing soy beans in a near-by section, and although watchman service was provided, the first alarm came from a passing motorist, who saw flames as he drove by the mill. The motorist drove two blocks to a filling station and telephoned the Cairo Fire Department. This alarm was received at 4:45 A.M. At 4:50 A.M. an alarm was received from the plant office. The night plant manager, the watchman and another employee each claim to have given this alarm.

Fire Fighting Operations.

The Cairo Fire Department responded promptly on the first alarm with a 750 g.p.m. pumper and a hose truck. However, upon arrival they found the mill building and the warehouse completely involved. Flames had spread swiftly over the lint-coated structural members of the building. Firemen also found that the roofs of Sections 10 and 24 of the plant had fallen in, breaking ten six-inch sprinkler risers.

The fire department pumper truck went off the road and became stuck in the mud before it reached the first hydrant, and this resulted in a thirty-minute delay in getting hose streams on the fire. Firemen attempted to use direct hydrant streams on the blaze, but the broken sprinkler risers were wasting so much water that these streams were ineffective. The fire chief, realizing the effect of the broken sprinkler risers on the available water supply, made futile efforts to find someone familiar enough with the plant to close the proper sectional control valves. This was not done until almost 8:00 A.M., when a plant maintenance man arrived and closed two post indicator valves, thus stopping the flow of water and providing supplies for three hydrants.

Meanwhile, the chief of the Cairo Fire Department had telephoned the U. S. Coast Guard Fire Patrol for assistance. They arrived at approximately

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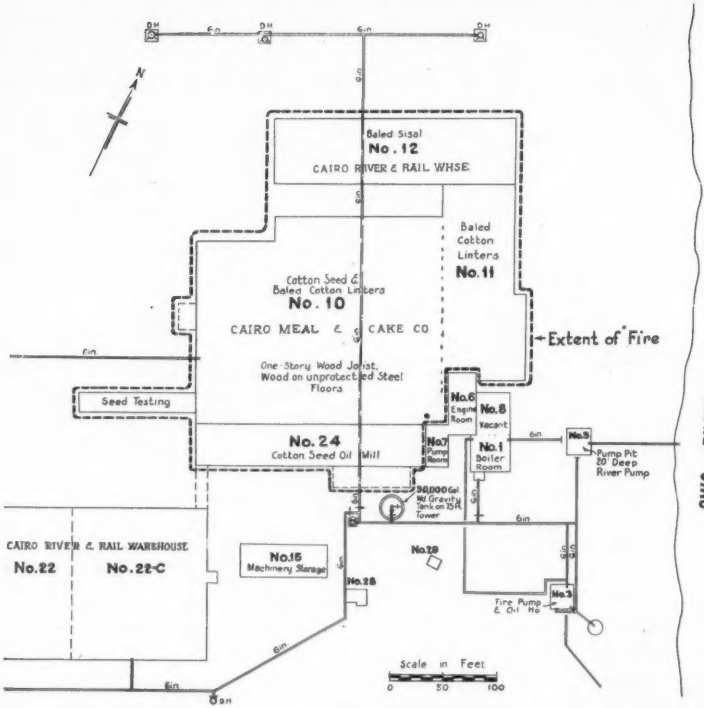
NOTE: This account is based on reports received from Chief J. W. Mason of the Cairo Fire Department and from the Illinois Inspection Bureau (Member N. F. P.A.).



5:45 A.M. with a 500 g.p.m. pumper trailer carrying 500 feet of hose and a fireboat equipped with four 500 g.p.m. pumpers. The Coast Guard pumper trailer was delayed in its arrival because an Army truck had to be obtained to haul the trailer.

The Coast Guard pumper was stationed at one hydrant and provided protection for Sections 22, 22B and 22C of the mill. The Cairo Fire Department pumper was dug out of the mire and used one stream to wet down Office Building 9. Two more hose lines were brought into operation by the Coast Guard fireboat working from the Ohio River. These two streams were credited with saving Building 15 and Sections 1 and 8.

The fire was finally extinguished after a seven-hour battle. The loss is estimated at $1,650,000. The damage was total to Sections 7, 10, 11, 12 and 24, and heavy to Section 6.

Conclusions.

Inadequate water supply and an obsolete sprinkler system were the major contributing factors to this large loss. It is believed that the unsatisfactory operation of the antiquated sprinklers was due to the intensity of the blaze and

the speed with which it swept through the combustible contents of the old frame building. There is also a strong possibility that the 1000 g.p.m. automatic steam fire pump, which was the primary source of water supply, went out of operation shortly after the fire started. The pump was not working at 8:00 A.M., as the steam pressure had gone down when intense heat prevented the employees from attending the boilers. The breaking of the sprinkler risers also contributed to the inadequacy of the water supply and delayed the fire department in getting effective hose streams in operation. The fact that no one, either among the plant employees or in the fire department, knew the location of the valves to shut off the sprinklers was another contributing factor to the large loss.

This fire clearly demonstrates the danger of storing high-value merchandise in an old building of combustible construction, lacking in both private and public fire protection, and housing a hazardous occupancy.

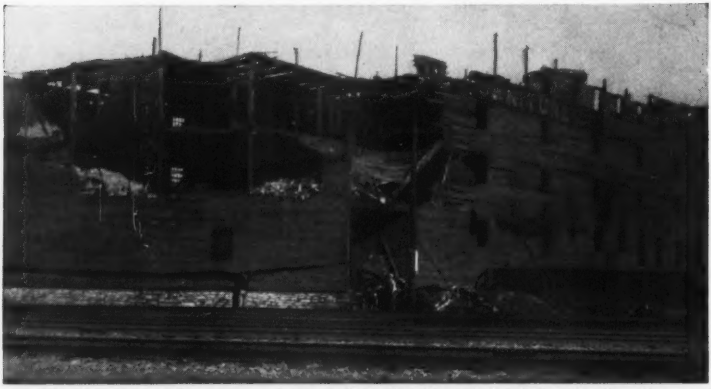
Minneapolis Furniture Warehouse Fire.

The danger of unsprinklered spaces under the floors of large, sprinklered buildings was forcefully illustrated by a fire in the warehouse of the Luger Furniture Company in Minneapolis on April 3, 1943. Automatic sprinklers are designed to control fires in the rooms where they are installed and under such conditions have a very fine record of efficiency. Sprinklers, however, are under a handicap when fire starts in an unsprinklered space under a building and spreads through a large area which cannot be reached by the water from the sprinklers.

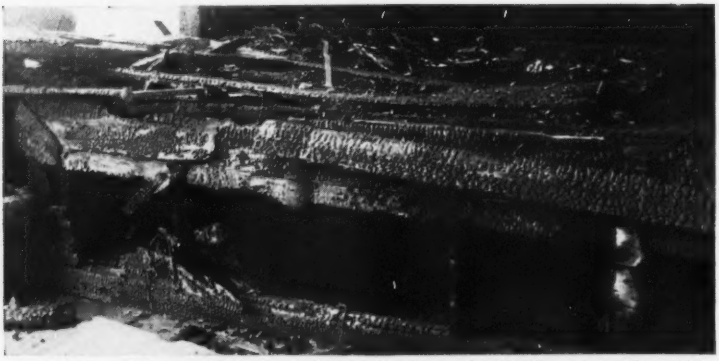
The Luger Furniture Company warehouse was a large four-story frame building protected by a dry pipe automatic sprinkler system installed in 1902. The original heads had been replaced in 1923, but there was some question about the condition of some parts of the system. The only water supply was from the city mains.

Under the building was an unsprinklered space about three feet high, generally closed but having several openings for ventilation. Fire started in this space on a Saturday afternoon. The cause of the fire is thought by the fire department to have been careless smoking, as a number of men in and around the building shortly before the fire, including the watchman, had been smoking, and it is considered likely that a match or cigarette might have fallen under the building and ignited combustible rubbish, smouldering for some time and involving a large area before discovery.

NOTE: This account is based upon reports received from Assistant Chief Arthur P. Spottswood, Chief of the Minneapolis Fire Prevention Bureau, and from the Fire Underwriters Inspection Bureau (Members N.F.P.A.).



The four-story frame warehouse after the fire of April 3, showing the good stop made by the fire department.



The fire originated in the unsprinklered space under the floor near this point, spread through the under-floor area and up open elevator shafts to involve the entire building.

Smoke was finally observed by the watchman. Very soon fire was coming up through the floor and extended upward through unprotected vertical openings to involve the entire four-story building. The fire department responded promptly and did a very commendable job in preventing complete destruction of the building. Twenty-seven hose streams were supplied by fire department pumpers taking suction from the same city mains that supplied the sprinkler system. Fire department attempted to augment the low pressure public supply by pumping into the sprinkler system, but the fire department connections of the system failed apparently owing to lack of proper maintenance. After this the sprinklers were of very limited value, although the fire department gave them credit for holding the fire in check until hose streams were in operation.

Fire Hazard Tests of Building Materials.

By A. J. Steiner,
Underwriters' Laboratories, Inc.
(Member N.F.P.A.)

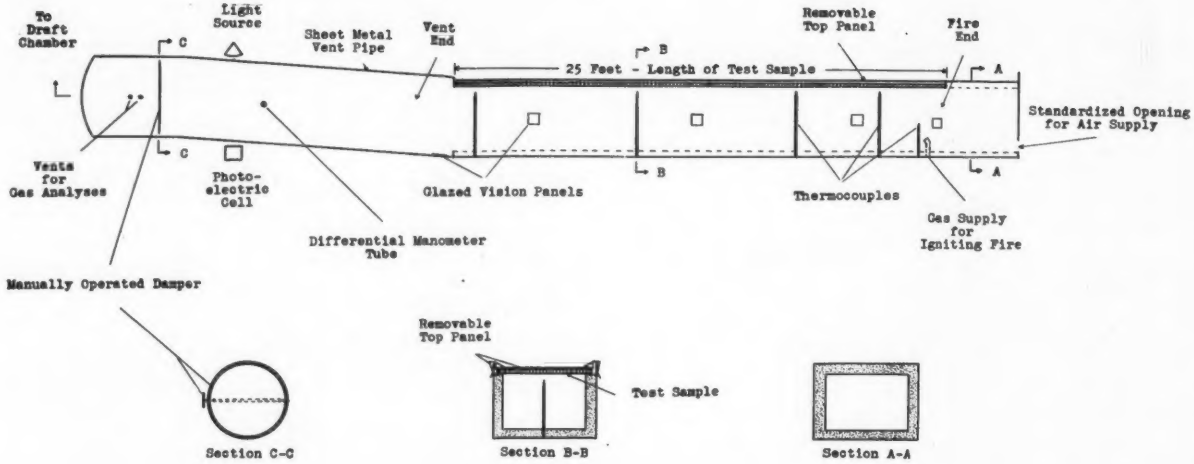
A method of testing and classifying the fire hazard characteristics of building materials and materials used for interior finish has recently been developed by Underwriters' Laboratories, Inc. The fire hazard of a material is its property of burning and spreading fire. This is entirely different from its fire resistance, which is its property of withstanding fire from the burning of other materials. The fire resistance of building materials has for years been determined by fire tests conducted in accordance with the Standard Fire Test Specifications, and the results are reported in terms of hours on the standard time-temperature curve. Tests for fire resistance, however, do not necessarily provide any criteria of the fire hazard of the surface. The method described in this article was developed to meet the need for a standard method of testing to evaluate the relative fire hazard of materials used in the interior finish of buildings.

When a material is used as a finish for acoustical purposes or decorative trim, etc., on walls, ceilings, floors, or other surfaces in buildings, it may or may not affect the fire hazards at the place of use according to the extent to which it permits spread of flame over its surface, contributes fuel to a fire or generates objectionable smoke when burning. The extent of increase or decrease in fire hazard of a particular material used in a given location depends upon its performance with respect to these three properties as contrasted with the performance of other available and suitable building materials.

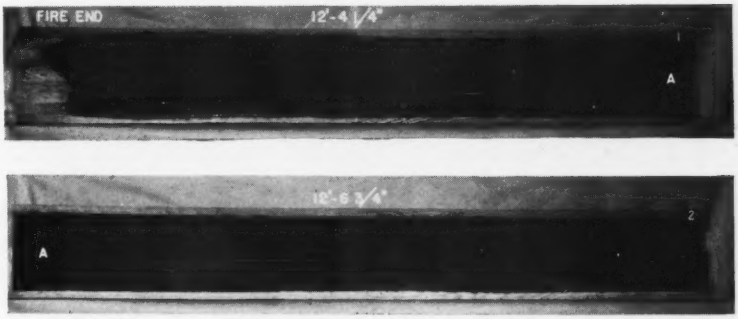
Until now, judgment has been the common method of classifying the fire hazard of various materials if, as is seldom, attempts are made to classify or rate them. Experience gained in observation of the spread of and damage by fire has been the principal factor in exercising judgment. During recent years, however, new materials or compositions with respect to which experience is not at hand make judgment in classification erratic and possibly, in some cases at least, seriously erroneous.

Many years ago Underwriters' Laboratories, Inc., devised a method* for deriving numerical ratings for common and proprietary products (principally liquids) as to their fire hazards. Its success encourages the hope that numerical

*See publication "Underwriters' Laboratories, Inc. Method of Classification of the Hazards of Liquid, March, 1929," summarized in N.F.P.A. QUARTERLY, Vol. 22, No. 2, page 258. A recent edition of this publication has been issued, dated June, 1943.



Cross section of test equipment used for fire hazard classification of building materials.



Typical appearance of a test surface after exposure to fire. The two sections together form the 25 ft. long test surface.

ratings for fire hazards for building materials may aid those concerned with one or more aspects of the fire loss problem.

Development of Test Procedure.

The test methods described herein and the development of the classification factors pertaining to fire hazard properties of building materials are based on certain phenomena of performance under fire exposure conditions. In attempting to reproduce in laboratory tests the conditions which will create performance consistent with that established by field experience, it was necessary to assume that certain materials will produce certain conditions. By adjustments whereby fuel and air are supplied and controlled in proper proportion, favorable conditions can be created whereby the fire hazard properties of any material will be indicated and provide a basis of comparison of the fire hazard properties with other materials. It is assumed that wood will burn and under proper conditions fire will spread on the surface, and that materials made from incombustibles, such as cement and asbestos, will not contribute to fire conditions. Thus for classification purposes, two kinds of building materials of consistent character, commonly available, were chosen as representative of widely differing fire hazard characteristics, namely, cement asbestos board, which was taken as the low or zero point of a numerical scale for fire hazard, and select red oak lumber for the high or 100 point in a decimal rating method.

To illustrate, test results are given in the following section of the above-mentioned two building materials, and of three others which have been obtained in two grades from commercial stock, namely, one grade each of cellulose board and felt, in their "natural state," and treated to reduce fire hazard, also one grade of pine, one treated against decay and the other against decay and ignition.

Description of Test Equipment.

The fire test equipment (see diagram) consists of a duct having inside dimensions 11½ in. in height, 17 in. in width, and 25 ft. in length. The sides and base of the duct are noncombustible material. The roof or top is removable, and consists of a structural framework with the lower face covered with a solid flat noncombustible material to which the test sample, 20 in. wide and 25 ft. long, is applied as illustrated, page 71.

One end of the duct, designated as the fire end, is provided with gas burners delivering the flames vertically upward against the surface of the test sample and with an opening or intake regulated to deliver the desired quantity of air. The other end of the duct, designated as the vent end, is provided with a vent pipe in which photoelectric equipment for measuring the density of the smoke developed is installed; also a manually controlled damper to regulate velocities of air travel and tubes for samples of gases produced. One side wall of the duct is provided with glazed observation ports so arranged that practically all parts of the interior of the test duct and the exposed surface of the sample may be observed.

The temperatures within the test duct are determined by means of thermocouples inserted through the floor, the tip of the couples being located 1 in. from the exposed surface of the sample. Thermocouples are located in the flame of the igniting fire and 4, 8, 16 and 24 ft. beyond it. The gas supply for the igniting fire is controlled by a manual regulating valve installed with the diaphragm flowmeter in the gas supply line at the fire end. The air supply to the duct is taken through a standardized opening in the fire end, and damper control in the vent end is regulated by a differential manometer to give the velocities of 200 ft. per minute at the end of the test sample.

The smoke-measuring device consists of a photoelectric cell mounted on the lower face of the vent pipe 13 ft. 9 in. from the vent end of the test sample and connected to a microammeter. A light source is mounted opposite the photoelectric cell, the ray of which crosses the diameter of the pipe through which all gaseous products of combustion pass.

The sample of the material to be classified is mounted on the noncombustible under surface of the removable top of the duct in accordance with the method recommended for field installation. A steel framework serves as a structural support for the noncombustible surface to which the sample is applied and provides rigidity for handling and placing the sample in position on the duct and for its removal, as well as providing an air seal around its edges.

Method of Conducting Tests.

Throughout the tests observations are recorded of the general character, distribution and movement of the flame of the igniting fire and the flames and

gases, if any, developed by the sample. The temperatures developed in the test duct are indicated by a potentiometer connected to the thermocouples. The density of the smoke passing through the vent pipe between the photoelectric cell and the light source is measured in terms of microamperes. Samples of gases are taken for analysis for toxicity.

The duration of the test is generally 10 minutes, but may vary if the character of the material under test and developments during the test so require. If the fire progresses along the entire length of the test panel, the test is continued only long enough to complete observations of the character and intensity of the fire and smoke. If the fire progresses somewhat beyond the area initially covered by the igniting fire, but only slowly, the tests may be terminated when it becomes apparent that the limit of spread has been attained, and upon completion of observations of the attendant phenomena. If fire does not spread, the tests may be continued only long enough to establish stable conditions within the chamber, to take account of smoke phenomena, if present, and to determine to what extent the material may be contributing fuel or smoke even though not adding to the spread of fire.

At the end of the test the gas supply is shut off, fire and other conditions within the chamber are observed, and the top panel is removed. The sample is then examined in detail for information as to the area of fire spread and the condition of the material.

Interpretation of Test Results.

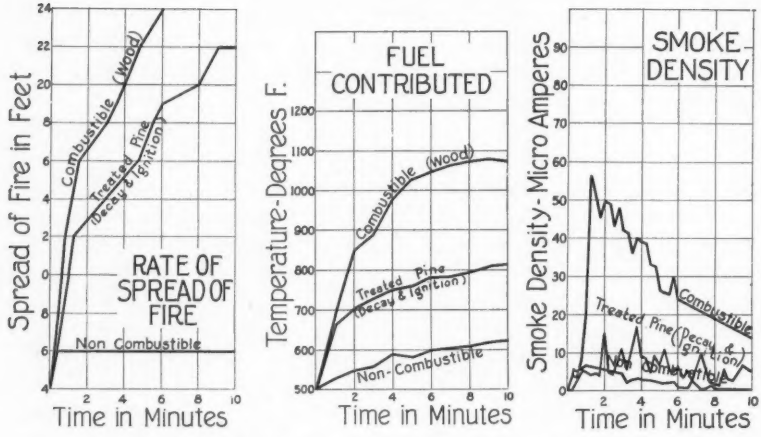
For purpose of comparison and classification, the data developed by the tests are separated into three divisions, representing the three properties herein considered as contributing to the fire hazard; namely, (1) contribution of fuel to an igniting fire, (2) rate of spread of fire, (3) density of smoke produced.

Contribution of Fuel.

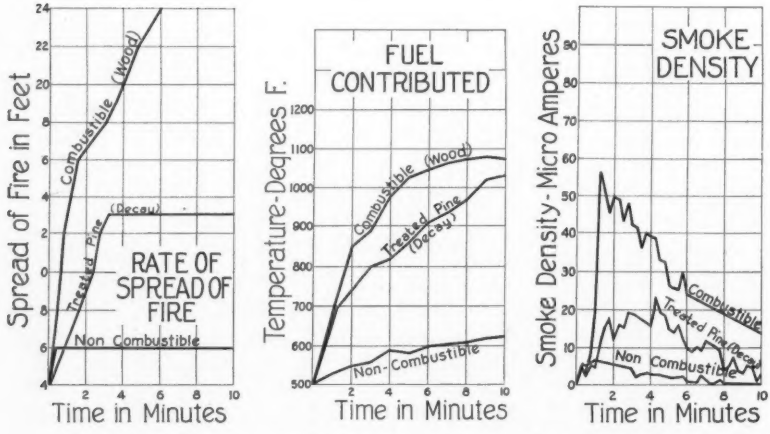
The contribution of fuel to an exposing fire is determined by the integration of the area below the curve created by the temperatures recorded during the test.

Assuming that the temperatures recorded during the test of an incombustible material indicate the heat units of the igniting fire, then the increase in temperatures in a test of a combustible material indicates the heat units contributed by that material. The integrated areas under the respective temperature curves can be taken as factors that are directly proportional to the heat units released.

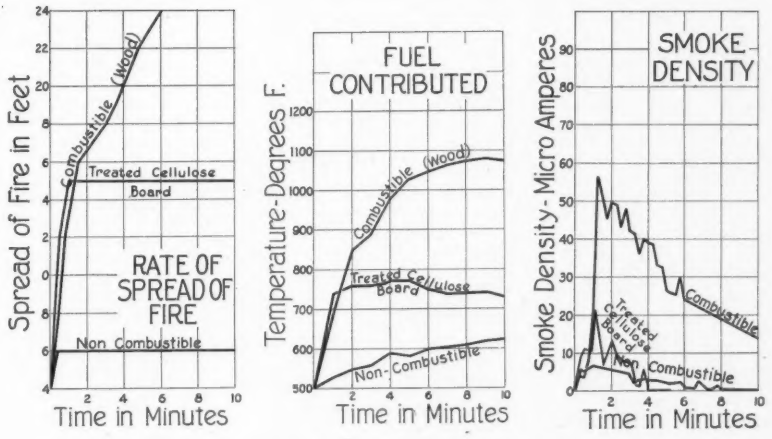
The area under the curve for an incombustible material is directly related to the B.t.u. content of the gas used, no heat units being released by the material and the fuel contributed is zero. The area under the curve for oak, for example, consists of the B.t.u. content of the gas of the igniting fire plus the heat units released by the burning of the oak, and this area minus the area for



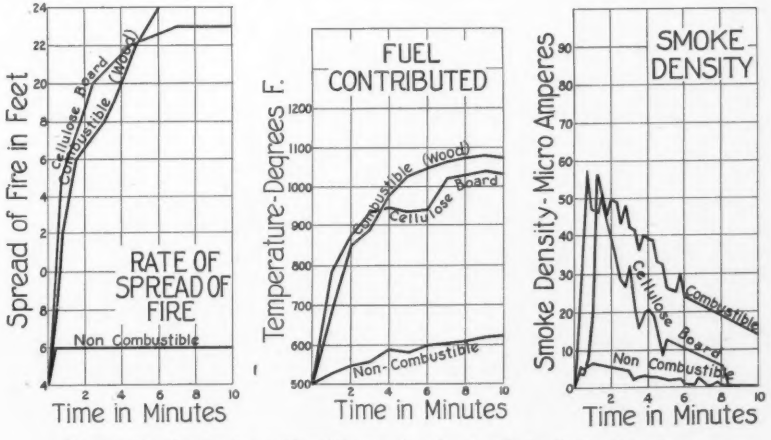
Curves showing test results with sample of pine wood, treated to retard ignition and decay, as compared with untreated wood ("combustible") and asbestos board ("noncombustible").



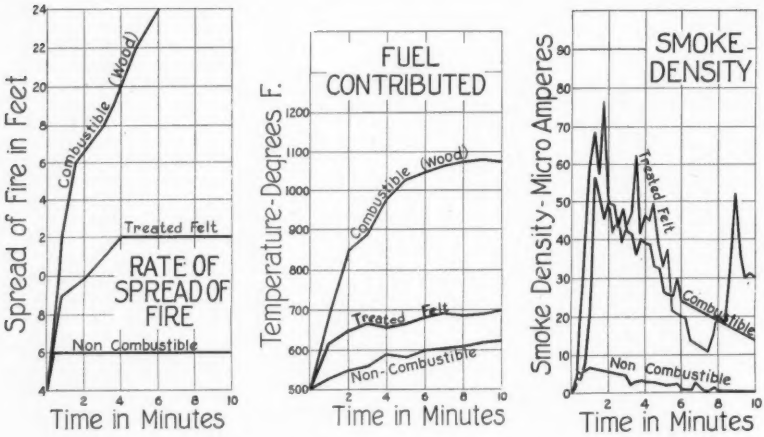
Curves showing test results with sample of pine wood, treated to prevent decay only, as compared with untreated wood ("combustible") and asbestos board ("noncombustible").



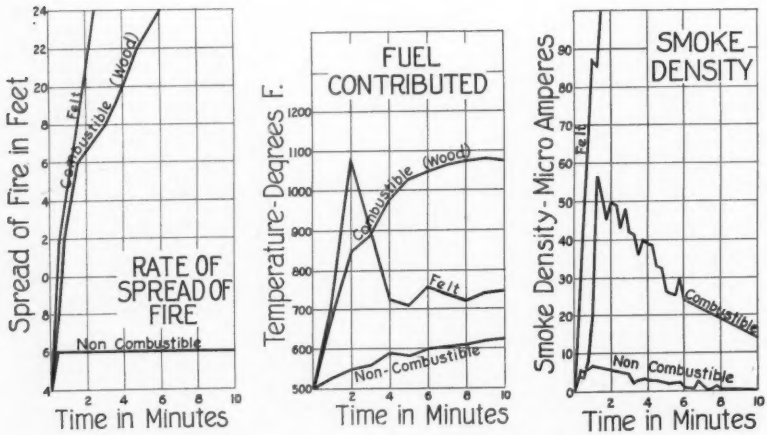
Curves showing test results with sample of cellulose board treated to retard ignition, as compared with untreated wood ("combustible") and asbestos board ("noncombustible").



Curves showing test results with sample of untreated cellulose board, as compared with untreated wood ("combustible") and asbestos board ("noncombustible").



Curves showing test results with sample of felt treated to retard ignition as compared with untreated wood ("combustible") and asbestos board ("noncombustible").



Curves showing test results with sample of untreated felt, as compared with untreated wood ("combustible") and asbestos board ("noncombustible").

the incombustible material can be considered to indicate the fuel contributed. For purpose of classification this net area is considered as 100 value or factor for fuel contributed.

The curves in the accompanying diagrams show the temperature recorded during the tests of eight materials; areas under curves identified as "incombustible" and "combustible" establish the zero and 100 factors of fuel contributed; the remaining six are the curves for the treated and untreated material previously mentioned.

By evaluating the fuel contributed for each material investigated, a numerical classification can be established as shown in the last column of the following table.

Reference Number of Materials	Area Under Curves	Fuel Contributed	Factor for Classification
Incombustible	410	0	0
Combustible	2250	1840	100
Treated pine (decay and ignition)	1760	1350	73
Treated pine (decay)	1220	810	44
Treated cellulose board	1195	785	43
Cellulose board	2145	1735	94
Treated felt	795	385	21
Felt	1360	950	52

Rate of Spread of Flame.

The spread of flame is determined by observing the time and extent to which flames have developed on the surface of the test sample as the result of the exposing fire. The curves in the diagrams show the spread of flame recorded during the tests of the eight materials previously mentioned.

The length of the flame produced by the igniting fire is 6 ft. when applied against an incombustible surface. This does not increase unless the material against which the flame is applied contributes fuel, as, for example, when the igniting fire is applied against oak, the flame spreads in 6 minutes to the end of the duct, or 18 ft.

The extent of the flame spread varies for different materials. Some materials will produce a spread of flame for a short distance, while with other materials the flames will spread indefinitely. The rate of spread also may vary from a flash fire to a slow spread. Therefore, the distance of spread and its speed are shown in the following table. On the basis of this table a comparison can be made with the distance and rate of spread of fire on basic materials, oak and cement asbestos board, which provide the 0 and 100 value or factor for flame spread.

By evaluating the distance or time of spread of fire for each material in comparison with basic material, a numerical classification can be established as shown in the last column of the following table.

Reference Number of Materials	Maximum Flame Spread and Rate Distance in Feet	Time in Minutes	Factor for Classification
Incombustible	0	..	0
Combustible	18	6	100
Pine (treated for decay and ignition)	16	10	89
Pine (treated for decay)	*7	3¼	39
Treated cellulose board	*9	1	50
Cellulose board	*17	7	94
Treated felt	*6	4	30
Felt	18	2½	240

*Spread of flame did not continue beyond the distance indicated.

Smoke Density.

Smoke developed is determined by recording the reduction of light due to smoke passing between the light source and the photoelectric cell during the test.

If it is desired to classify relatively and on a comparative basis the smoke developed by the various materials, it is proper to assume a factor of 100 for oak and a factor of zero for cement asbestos board. The light absorbed during tests of the eight materials previously mentioned is shown by the curves in the accompanying diagrams. The integration of the areas under the curves can be considered as proportional to the light absorption by the smoke, and a numerical classification can be established as shown in the last column of the following table.

Reference Number of Materials	Light Absorption	Relative Volume of Smoke	Classification Factors
Incombustible	145	0	0
Combustible	1380	1235	100
Pine (treated for decay and ignition)	560	415	34
Pine (treated for decay)	330	185	15
Treated cellulose board	180	35	3
Cellulose board	865	720	58
Treated felt	1725	1580	128
Felt	Excessive	..	Excessive

The classification developed by fire tests conducted in accordance with the method described above provides information on the fire hazard of materials, and it is not proposed to specify them for definite uses such as duct lining, acoustical correction, interior finishes or top flooring. It is expected that the numerical factors will be of assistance to authorities having jurisdiction in deciding the propriety for the use of certain material for a given location. This classification method has already been used satisfactorily in providing the desired information on a number of materials.

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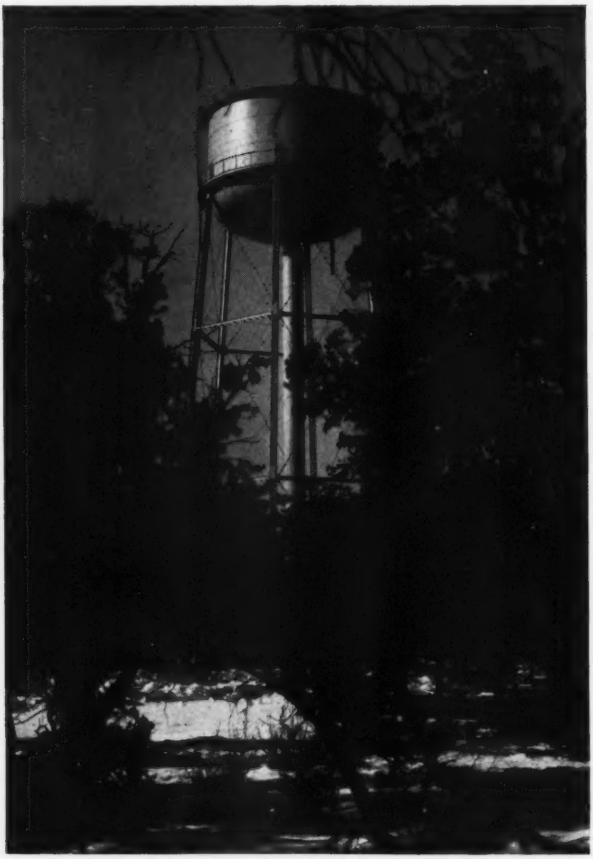

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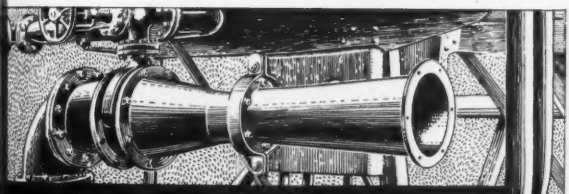

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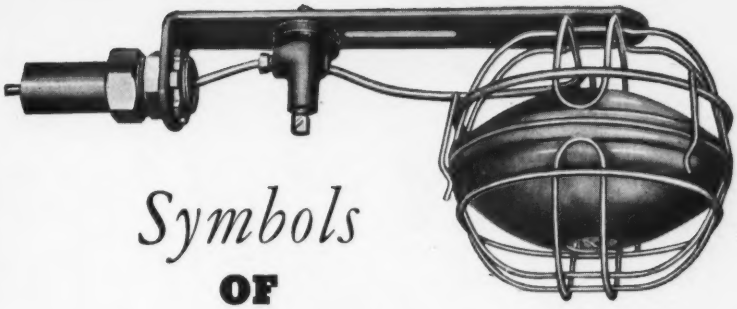
Indiana Automatic Sprinkler Co.
Indianapolis, Indiana
Texas Automatic Sprinkler Co.
Dallas, Texas
Walton Viking Company
Kansas City, Mo.
Viking Automatic Sprinkler Co.
Boston, Mass.
Viking Automatic Sprinklers, Inc.
Buffalo, New York
Viking Automatic Sprinkler Co.
Chicago, Ill.
Viking Sprinkler Co.
Cincinnati, Ohio
Viking Sprinkler Co.
Detroit, Michigan
Viking Automatic Sprinkler Co.
Los Angeles, California
Viking Sprinkler Co.
New York, New York
Viking Sprinkler Co.
Philadelphia, Pennsylvania
Viking Automatic Sprinkler Co.
Seattle, Washington
Viking Automatic Sprinklers, Ltd., Toronto, Ontario, Canada

THE VIKING CORPORATION
HASTINGS, MICHIGAN



Symbols OF *Leadership* IN FIRE PROTECTION ENGINEERING

"AUTOMATIC" OF AMERICA

★ For 50 continuous years "Automatic" has advanced the Art of Fire Protection. "Automatic" Engineering and Research Staffs are constantly improving Wet and Dry Pipe Sprinkler Equipment, and developing new apparatus for newly recognized hazards.

"AUTOMATIC" SPRINKLER RATE OF RISE CORPORATION OF AMERICA

"Automatic" sprinkler systems continually meeting the test of actual fires successfully, has won for them the approval of fire insurance companies, government officials and industrial managements.

"Automatic" is now installing sprinkler systems delivering water in less than ONE SECOND after the outbreak of fire for the protection of life and property vital to the prosecution of the war.

"Automatic's" experience in hydraulic computations and specialized engineering assistance for your every need is available without cost by application to our offices in the principal cities of the U. S. A. and Canada.

★

"AUTOMATIC" SPRINKLER CORP. OF AMERICA

YOUNGSTOWN, OHIO • OFFICES IN PRINCIPAL CITIES

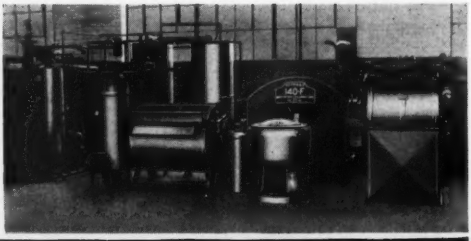
LOOK AT THE RECORD MADE BY HOFFMAN

140-F SAFETY DRY CLEANING

It's a record to be proud of—the clear loss record made by the Hoffman 140-F drycleaning system, in hundreds of installations during the past six years! The point is—this is Petroleum Solvent Equipment—not a chlorinated solvent unit! It's the original Safety Petroleum Solvent Unit—an exclusive U. S. Hoffman development to promote greater safety in the drycleaning industry. An approved Class II system, the 140-F complies with standards of National Board of Fire Underwriters Pamphlet No. 32. Most inspection departments permit installation without enclosing walls.

USES 140° FLASH PETROLEUM SOLVENT

The Hoffman 140-F drycleaning system employs safety solvent with flash-point of approximately 140° F. The system is offered to the drycleaning industry in 12 different types—each one tested and listed by the Underwriters' Laboratories Re-examination Service.



U. S. HOFFMAN MACHINERY CORPORATION
105 Fourth Ave., New York 3, N.Y.
DRY CLEANING. LAUNDRY & GARMENT PRESSING EQUIPMENT

FACT-O-CRETE floors

A Moderate Cost, Light Weight, Seamless, Heavy Duty Floor Laid in Plastic Form Over Wood . . .

★ FIREPROOF ★ OILPROOF
★ WATERTIGHT ★ PAINTPROOF
★ SPARKPROOF ★ WEARPROOF

★ Recommended by Fire Underwriters to Prevent Water Damage and Spark Hazard in Spray Booth, Paint Storage and Similar Industrial Areas.

• In 1927 a fire starting in the finishing room on the top floor of this furniture factory released the sprinkler system. The loss attributable to fire was $30,000—that to water damage amounted to nearly $500,000. Fact-O-Crete, laid over the entire spray booth area, forming a drained, watertight pan with 6-inch high wall and column bases and floor ramps, has positively prevented a recurrence. The original floor after 16 years of service still passes the Underwriters' requirements.

FACT-O-CRETE easily and rapidly installed is fully guaranteed. Cost estimates and specifications for installations given promptly upon receipt of job conditions and areas.

FREE Sample: Write for a full size sample of Fact-O-Crete showing its application to a wood subfloor.

Warehouses in Wichita, Kansas, and New York City.
Address all correspondence to

E. H. O'NEILL FLOORS COMPANY
105 West Adams St., Chicago, Illinois

O'NEILL FLOORS

It Welds Steel . . .
Yet Won't Ignite This Canvas!

This actual, unretouched photograph of a white-hot oxyacetylene torch flame billowing off a FIRE CHIEF Canvas welding curtain, tells more than a thousand words. Yet fire resistance is only part of the story.

This HOOPERWOOD "Engineered Canvas" is equally resistant to water, weather and mildew, greatly lengthening its life in service.

"Canvas Engineering" is opening up new broad fields of usefulness — offering advantages many products will benefit from when the peace is won and our entire production is no longer required by the armed forces.

To mention but a few — awnings that won't ignite from carelessly tossed cigarettes or rot from mildew — special canvas truck covers that will outlast their predecessors several times over — canvas marine supplies that will help strike out the fear of fire on shipboard — aircraft canvas fabrics that repel gasoline and oil.

These and many other applications of "HOOPERWOOD - Engineered" fabrics for Business and Industry will be waiting for you when conditions return to normal.

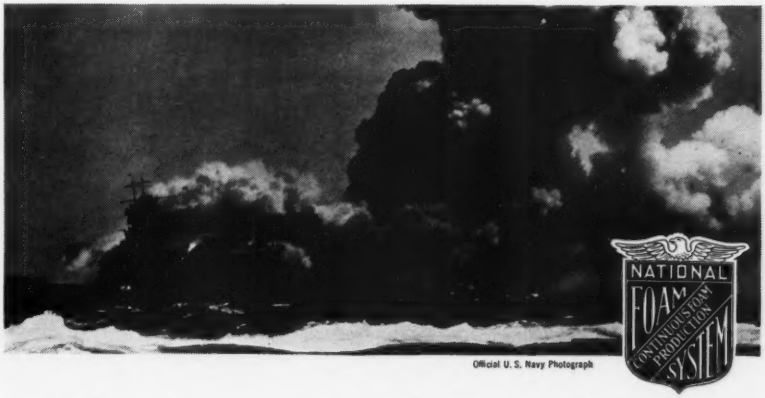
WM. E. HOOPER & SONS CO.
New York PHILADELPHIA Chicago
Mills: WOODBERRY, BALTIMORE, MD.

•

Since 1800 (through six wars) the HOOPER name has symbolized highest quality in Cotton Duck and other Heavy Cotton Fabrics, Paper Mill Dryer Felts, Filter Cloth, Rope, Sash Cord.

• *Fire-Chief Finished* •

HOOPERWOOD COTTON DUCK



Official U. S. Navy Photograph

National Foams for Difficult Fires

National Foams have been developed for extinguishing the most hazardous and difficult types of fire especially where water cannot control or is ineffective. Equipment for the application of National Foam has been evolved to meet every known requirement — from the small blaze to oil refinery blasts or fires on ships at sea.

National Foam System, Inc., is the evolution of an organization whose business since 1819 has been to promote better methods of fire fighting. Fire foam and necessary equipment for its application have been developed and perfected by National Foam System, Inc., who are recognized authorities in this field.

National Foams excel under this four-way test:

They flow evenly and spread to make a flowing blanket.

Bubbles cohere forming a gas-tight cover.

Adhere tenaciously to surface covered.

Foam remains intact sufficient time to extinguish the fire and prevent flash-backs.

National Foams are in use by most oil refineries and many other important industries. They have been adopted and are used extensively by the U. S. Navy.

Our engineers will gladly consult with you and advise regarding the type of equipment which will most effectively meet your needs.

NATIONAL FOAM SYSTEM, INC.

Specializing in Foam Fire Protection

1632 Sansom St., Philadelphia, Pa.

GUNS!

BULLETS!

SPRINKLERS!

Vital Wartime Essentials! Star Automatic Sprinklers defeat the saboteur whose chief weapon is fire — Combat our enemies by guaranteeing uninterrupted war production — Preserve critical materials for our armed forces — Protect the assets of our Nation!

Automatic Sprinklers
Corrosion-proof Sprinklers
Directional Flow Sprinklers
Open Sprinklers
Ornamental Sprinklers
Alarm Devices

Automatic Releases
Alarm Valve (Wet) Systems
Dry Pipe Valve Systems
Deluge Systems
Heat-Actuating Devices
Pre-Action Systems

Star Automatic Sprinklers and Fire Protection Devices bear approval of all Insurance Authorities having jurisdiction and various Governmental Agencies.

Economy in installation cost and maintenance has dictated the consistent policy of Star Sprinkler Corporation in distributing its Fire Protection Devices through local licensed contractors who have had a lifetime of experience in the installation of automatic sprinkler systems. Operating throughout the United States, Canada and South America, Star licensees, due to their strategic locations, can render instant service. Write us for name and address of Star licensed contractor nearest your location.

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. - Philadelphia, Pa.

IN EVERY CLOUD THERE LURKS A POTENTIAL ENEMY . . . . . .

LIGHTNING!

In protecting against Lightning you also eliminate other possible hazards, thus preserving your plants and material and affording safety and security to your manpower for vitally essential production.

Let our engineers aid in designing your Lightning Protection Systems in accordance with the latest revised Codes just recently promulgated.

Either send plans of your buildings or call us in. No obligation incurred.

ELECTRA PROTECTION COMPANY, INC.

General Offices: 11 North Pearl Street, Albany, 7, N. Y.
Service Offices: 420 Lexington Avenue, New York, N. Y.
And in other Southern and Western cities.

Please furnish ☐ Data ☐ Estimate for

☐ COMPLETE LIGHTNING PROTECTION ☐ MATERIALS ONLY

☐ Igloos or Underground Magazines ☐ Above Ground Magazines
☐ Ammunition Manufacturing Buildings ☐ Ammunition Loading Buildings
☐ War Production Plants ☐ War Storage Depots ☐ Water Towers
☐ Buildings with Explosive Gas, Dust or Vapor Hazard ☐ Oil Tanks and Reservoirs
☐ Stacks or Chimneys ☐ Hangars ☐ Signal Towers ☐ Chapels

or.....

Specified Material: ☐ Galvanized Cable ☐ Star Section Rod ☐ Copper ☐ Copperweld

☐ LIGHTNING ROD INSPECTION SERVICE on.....

.....PROJECT

☐ STATIC MITIGATION SERVICE for.....

.....PROJECT

This information needed on or before.....194.....

See our Mr.....on.....194.....

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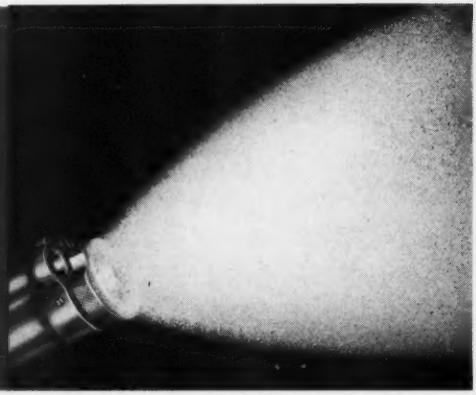
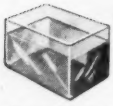
NOW WATER *Kills* OIL FIRES



because WaterFOG obeys this rule of physics

THE SPEED WITH WHICH WATER ABSORBS HEAT INCREASES WITH THE SURFACE AREA EXPOSED



Suppose a "cube" of water has so much surface area. Turning it into a stream increases its surface area.

Breaking it into spray increases it even more. But still that same amount of water is not yet in proper form for fighting flammable liquid fires.

It takes WaterFOG — extremely tiny particles—to give that original quantity of water enough surface area to take heat from an oil fire fast enough!

Furthermore, being light, WaterFOG stays longer in the combustion zone—unlike larger drops which plunge into the liquid, agitating it, encouraging vaporization. WaterFOG, floating down onto the surface, absorbs a maximum amount of heat from the flames and lowers the temperature of the liquid. Then, changing into steam, it expands and envelops the fire in a smothering blanket.

WaterFOG—created by impinging streams of water—is engineered in correct particle size, fog pattern, and velocity for your conditions. Fixed piping installations, hose nozzles and applicators. Rockwood installations approved by Underwriters' Laboratories and Associated Factory Mutuals, used by Navy, Coast Guard, hundreds of industrial plants. WaterFOG is safe to use on electrical fires. Write for Bulletin 123.

Executives! A colored movie (16 mm.) showing tests of Rockwood WaterFOG is available.

ROCKWOOD SPRINKLER CO.
56 Harlow Street, Worcester, Mass.
Specialists in Fire Protection Engineering, Equipment and Installation since 1907

Thus WaterFOG attacks fire 3 ways:

1. **Quenches the burning vapors**
2. **Lowers liquid temperature to retard vaporization**
3. **Diminishes supply of oxygen**

ROCKWOOD **WaterFOG**

WATER, ENGINEERED BY ROCKWOOD, COOLS, CONFINES, SMOTHERS OIL FIRES

WHERE IS THE NEAREST
FIRE ALARM BOX?

for FIRE USE THE NEAREST BOX NO.
AT
and wait for the Firemen
DO YOU KNOW THAT
600,000
fires occur annually in the U.S.A.
10,000
human lives are lost and
100,000
others are seriously injured and
$400,000,000
in property values plus the indirect losses creating a total waste in excess of One Billion dollars are annually destroyed by Fire.
70%
of the fires — and life losses occur in dwellings.
43%
of the commercial establishments destroyed do not rebuild, and the community loses prestige, business, payrolls, taxes and wealth.
50
times its original size is the spread of fire within 5 minutes after inception.
WHEN FIRE OCCURS—
Use the Box IMMEDIATELY
Delayed Alarms are largely responsible for the excessive Fire Loss.
The Box Is Your Best Protection
FIRE DEPARTMENT

INSTRUCTION CARDS

PROMINENTLY DISPLAYED

in every building will inspire "fire consciousness" and proper action when fire occurs. Fire signaling facilities were never more urgently needed, but scarcity of materials necessitates greater dependence upon existing boxes. Their prompt use for fire will conserve national resources.

THE GAMEWELL COMPANY

NEWTON UPPER FALLS, MASSACHUSETTS

When Fire Strikes . . .

Before the war, when fire struck an unprotected industrial plant, it often destroyed or seriously crippled an individual enterprise. Regardless of insurance coverage, valuable records were destroyed, customers were lost, and trained employees sought work elsewhere.

Today, when fire strikes a plant or its vital war materials, it is not just an individual calamity. It is a serious loss to a whole nation at war! Sorely needed supplies and irreplaceable equipment are destroyed . . . man hours are lost . . . the nation's war production program suffers.

There is one sure way to keep a plant producing and helping to win the war. That is to install a Grinnell Automatic Sprinkler System. There is a type of system for every fire hazard. Each is designed to provide the utmost in automatic fire protection for specific conditions. Complete information is available for the asking from any of our offices throughout the country. Grinnell Company, Inc., Executive Offices, Providence, R. I.

GRINNELL

AUTOMATIC SPRINKLER FIRE PROTECTION